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Forthcoming Events.

JANUARY 16.

Institute of Metals (Swansea Local Section):—Ordinary meeting at Swansea. "Alloys and Their Properties." Paper by Professor C. A. Edwards, D.Sc.

Institute of British Foundrymen (Sheffield and District Branch):—Ordinary meeting at Fargate. "Recent Developments in the Manufacture of Electrical Iron and Steel Castings." "A Résumé of German Cost and Methods." Paper by Dr. S. G. Weoner.

West of Scotland Iron and Steel Institute:—Annual dinner, at Glasgow.

Society of Chemical Industry:—Joint meeting with the Chemical Engineering Group, in London. "The Low Temperature Treatment of Bituminous Materials." Paper by T. W. Stainer Hutchins.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

Institute of British Foundrymen.

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Dignity in Foundry Advertising.

Last week we published a humorous letter by "Quiz," which raises the question as to whether there is not a certain unbecoming measure of frivolity in some of the displayed advertisements and circularised matter addressed to foundrymen. From a personal acquaintanceship with something like a thousand members of the industry, we have received the impression that they like to be treated seriously in all business matters. The types we have met would certainly not appreciate being addressed as "Mr. Foundryman." Whilst it may be thought that to some extent the proprietors are responsible in allowing so much latitude, we would draw attention to two factors. Primarily, we are assured that this type of advertisement gets business, and, secondly, the advertisers purchase white paper: and so long as they keep reasonably decorous, we feel they have the right to fill it with such matter as they know from experience will appeal to the buyer. Thus, it appears that the large section of people with a buying capacity in the foundry trade welcome such matter.

The whole question thus boils down to one of supply and demand, and when the demand for Americanised advertisements ceases then the supply will stop; certainly, in advertising matter an effort should be made to catch the eye, but the balance should preferably be a serious appeal. This basic principle has apparently been overlooked by some firms, and the whole of the matter is devoted to "catching the eye." THE FOUNDRY TRADE JOURNAL is essentially a technical paper, and it can reasonably be assumed that its readers have some technical knowledge; they are not impressed by the "best in the world" type of advertising, but look for statements showing technical features, outputs, references, and the like. We believe some foundry firms make the mistake of having too much foundry "atmosphere" into their advertisements, which only too often unbalances the appeal. Others will make references to their competitors—an obvious basic error in advertising. One glaring mistake made by an advertiser was to make a limited geographical appeal in a nationally circulating paper. We suggest that foundry advertisements should contain something to catch the eye; a little foundry atmosphere; a statement lending itself amplification by the salesman. The motto of the World's Advertising Congress was "Truth in Advertising," but so far as foundry advertising is concerned, "Dignity in Advertising" is equally pressing. The advertisers should help the foundryman to help himself to raise his status; it will pay him in the long run.

Critics of foundry advertising must take into consideration that if a machine is to be installed which will modify the whole conduct of the plant, then it is obviously a matter in which the owner or directorate will interest himself, whereas if it is a core binder, a plastic refractory, a mould facing, then normally the choice is left entirely in the hands of the man responsible for the quality of the casting. This, then offers some explanation of the varied character of the appeal made.

This new type of advertising is not too well appreciated by the leading men in the industry, and whilst advertisers have the right to express themselves as they feel will bring them the most business, we do suggest that they could do equally as well and still keep their publicity matter dignified. An appeal to an "ancient craft" combined with a modern industrial application of applied science warrants this.

War Memorial Bell for Italian Soldiers.

A massive bronze bell is being cast in Trent, to serve as a War Memorial for the fallen soldiers of Italy. When ready, it will be hung in the Castle of Roveredo, some 13 miles south of this city. Each evening it will ring in memory of Italy's soldiers who fell in the war. The bronze of which it is being made was derived from the guns captured from the enemy on the various Allied fronts.

The constructor had intended casting a smaller, silver bell, but funds from foreign countries came in so generously that he decided to cast a large bronze bell. Donations were received from Great Britain, the United States, France, and Czecho-Slovakia. On the bell are engraved scenes representing episodes of the war on land, at sea, and in the air, the triumph of the Allies, and groups bearing trophies of victory.

Book Reviews.

Mechanical World Year Book, 1925. Published by Emmott & Company, Limited, 65, King Street, Manchester. Price 1s. 6d.

This book has now reached its 38th year of publication, and has enhanced its reputation as a standard work of reference. This year a new section on "Notes on Foundry Work" has been included, and if any foundry contemplates making chilled car wheels, he will not only find the analysis of the raw and finished materials used but also the quantities of the former. All that remains for him to do is to tease the railway companies into drawing up a specification for their acceptance. This is the only actual mixture given, and is perhaps an unfortunate choice. Just over seven pages are devoted to foundry work, and include cast-iron mixtures; chilled castings; testing cast iron; moulding sands; cupolas; melting points of metals, and miscellaneous.

The contraction for aluminium is given as 1 in 60, but some authorities prefer to count on 1 in 80. The book, however, must not be judged on this one new section alone; it has established itself as a particularly useful reference book for foundry managers and firemen.

Foundrymen's International Convention in 1926.

While the holding of an international foundrymen's convention in America has been considered since the holding of the International Foundry Congress in Paris in 1923, no definite steps had been taken until the American Foundrymen's Association meeting in Milwaukee. At this time a resolution was adopted inviting the Canadian and European foundrymen to participate in an international gathering to be held in this country in 1926. The A.F.A. committee on conventions is now actively engaged in considering this undertaking. Because of the growth of international acquaintanceship among foundrymen and the desire to exchange industrial information, the holding of such a gathering in America can be made the most important meeting ever held.

The invitation addressed to the foreign foundry associations was the result of the unanimous action of the American Foundrymen's Association expressed by a resolution at the annual convention in Milwaukee during the week of October 13, 1924. Full appreciation of the entertainment courtesies extended and the opportunities afforded for technical investigation to the delegation from the American Foundrymen's Association during its visit in the summer of 1923 was the keynote of the resolution. The invitation concludes by saying:—"It is the desire of the members of our Association that they be accorded the privilege of reciprocating in a measure the generous and wholehearted hospitality of our European hosts of 1923. That the 'Entente Cordiale' now established between foundrymen on both sides of the Atlantic be stimulated and perpetuated is our sincerest wish."

Company News.

Electrolytic Zinc Company of Australasia, Limited.—Net profit, £341,349; dividends, £169,131; forward, £98,920.

A. Muir & Company, Limited, 50, Wellington Street, Glasgow.—Capital £50,000 in £1 shares. Iron merchants. Directors: A. Muir, J. Milroy and J. Muir.

J. G. Wolff & Company, Limited, The Empire Works, Upper Charles Street, E.C.1.—Capital £10,000 in £1 shares. Brassfounders, brassworkers, etc. Directors: J. G. Wolff, S. Wolff and P. H. T. Wolff.

Kemp & Nicholson, Limited, 16, Forth Street, Stirling.—Capital £10,000 in £1 shares (2,000 preference, 5,000 ordinary, and 3,000 to be ordinary, preferred or deferred). Engineers. Directors: J. K. Smith and W. T. Morrish.

Thomas Collins & Company, Limited.—Capital £35,000 in 14,000 7 per cent. cumulative preference and 20,900 ordinary shares of £1 and 2,000 management shares of 1s. each. Engineers. Directors: T. B. Collins, 16, Ashley Hill, Bristol, and F. H. Bonner.

Le Bas Tube Company, Limited, Dock House, Billiter Street, E.C.4.—Capital £50,000, to acquire the business of Edward Le Bas, manufacturer of and dealer in tubes and fittings, Cyclops Works, and Victoria Wharf, West Ferry Road, Millwall. E. Le Bas permanent director and chairman.

Calendars, etc., Received.

Messrs. Crofts (Engineers), Limited, Bradford, have sent us a monthly tear-off wall calendar; **Messrs. British Pig-irons, Limited**, Abbey House, 2, Victoria Street, London, S.W.1, decorative tear-off wall calendar; **Messrs. S. W. B. Stephen & Company**, Smethwick, monthly tear-off wall calendar; **The Staveley Coal & Iron Company, Limited**, Chesterfield, pocket diary containing a fund of information useful alike to engineer and foundryman; **Messrs J. Stone & Company, Limited**, Deptford, London, S.E., waistcoat pocket diary; **Messrs. British and Continental Traders, Limited**, 50/51, High Holborn, London, W.C.1, a pocket diary containing a specially selected group of tables for use in the foundry trades; **Messrs. Pearson, Garforth, Limited**, Bradford, a monthly tear-off calendar; **Messrs. Watsons (Metallurgists), Limited**, Lancaster Street, Sheffield, pocket diary; **Messrs. Grandidge & Mansergh, Limited**, Wheathill Street, Salford, Manchester, monthly tear-off calendar; **United Carborundum and Electrite Works Company**, New Southgate, London, N.11, mechanical petrol pipe-lighter.

Cologne to have Largest Bell.

Cologne Cathedral is soon to have the largest bell in Western Europe, since it weighs over 25 tons. It was cast at Apolda, in Weimar State, where it has lain for a year in the foundry. Sentiment has hitherto prevented it from being hung in Cologne, during the foreign occupation of that city. Now, it is expected that the monster bell will soon be installed in one of the towers of the Dom.

MR. R. H. BOWEN, in a recent lecture to the Sheffield Foundry Trades' Technical Society, dealt with the importance of the moulder including a slide rule in his tool kit. Its use as a time-saver in characteristic foundry calculations was clearly demonstrated.

MR. C. EARNILL, who formed one of the party of the American Foundrymen's Association which visited Europe in 1923, has joined the staff of the Illinois State University, Urbana, Illinois, U.S.A., as instructor in the foundry laboratories. He was previously a foundry superintendent at Messrs. Fay & Scott, of Dexter, Maine.

MR. G. K. VICKERS, B.Sc., Birmingham, has been appointed Research Assistant to the Electric Steel Founders' Research Group, Chicago, and will be stationed at the Laboratories of the Michigan Steel Castings Company, Detroit. Mr. Vickers is the son of the President of the Birmingham Branch of the Institute of British Foundrymen, and for some time was with the British Cast Iron Research Association.

White Deposits on Castings.

By Ivan Lamoureux.

(*Translated from "Revue de Fonderie."*)

The white deposits referred to appear on the upper and horizontal faces of the massive portions of castings poured in dry sand. They are found in two forms. In thicknesses of 40 to 70 mm. (1.6 to 2.8 in.) only light grey dust is found, which can easily be removed with the metallic brush. Where the thickness is greater, this deposit takes the form of a fairly hard crust, the thickness of which may be several millimetres and which adheres firmly. In section, the metal has three

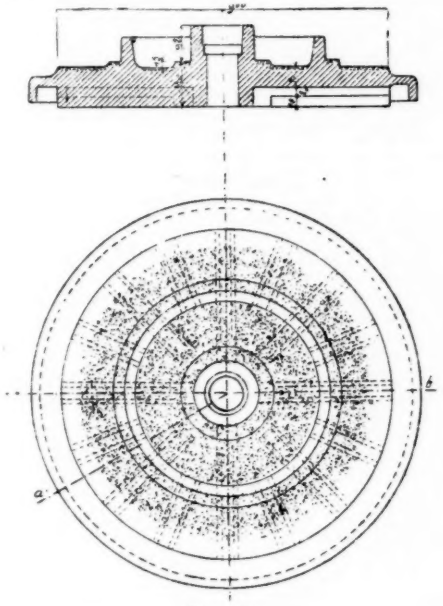

FIG. 1.

distinct aspects. Thus, in the specimen taken from the machine-tool table, shown in Fig. 1, the crust proper, which resembles quicklime, can be seen on the upper surface. Afterwards this crust is interspersed with grains of metal, and finally the sound metal appears.

Sometimes in the same casting, according to the thickness, this deposit is found at certain points in the form of dust, and at other points in the form of crust. In Fig. 2, for example, the deposit on the upper surface at *a* is a crust, while that beneath at *b* is in the form of dust.

Accompanying this Paper is a series of figures* showing on castings of various forms the part where the white deposits appear in the form of dust or a crust. Fig. 1 shows a machine-tool table, the deposit being dust. Fig. 2, a lathe-bed (at *a* the deposit is crust, at *b*, dust); Fig. 3, a lathe-bed (powder deposit); Fig. 4, a cylinder (powder deposit); and Fig. 5, a gate feeding massive casting, after prolonged pumping (powder deposit).

* All the figures in this paper are drawn in the position in which the castings were poured.

The crust deposit is frequently found at the upper part of large flywheels, counter-weights, etc. Apart from a grey tint with light brown points, its presence is only noticeable by striking the surface hard with a hammer. Instead of a clear ring only a dull sound is heard, and the hammer leaves an impression at each blow.

Effect of the Deposits.

The presence of these deposits is in no way a serious matter, for they are generally removed in the machining. In castings which are left rough they produce wrinkled surfaces. As will be seen later, they prove that the metal used is unsuitable for the casting.

Composition.

The difficulty of obtaining a sufficient quantity of this substance, which is indispensable for chemical analysis, renders the results rather uncertain. For the most part, however, these deposits appear to be composed of silica (SiO_2).

Origin.

The writer has made the following observations:—White deposits are never found when the

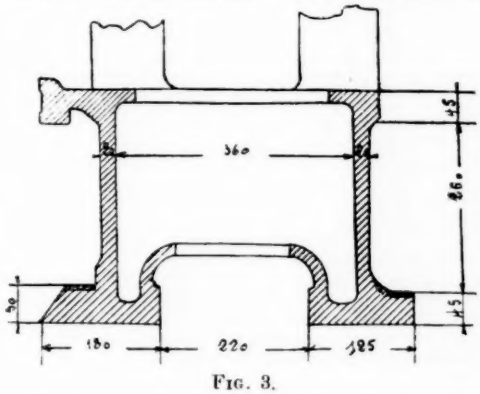

FIG. 3.

castings are run with the following metals:—(1) White pig, (2) mottled pig, (3) close-grained grey pig, and (4) pure grey pig containing less than 0.8 per cent. phosphorus, less than 3.25 per

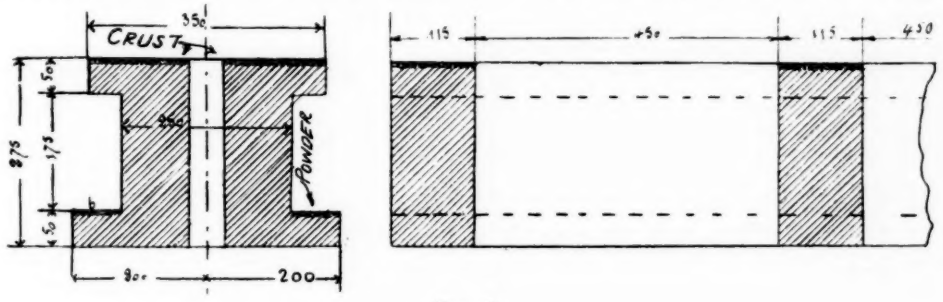

FIG. 2.

cent. total carbon, and less than 2.0 per cent. silicon.

Above the figures given under (4)—that is, with more than 0.8 per cent. phosphorus, more than 2 per cent. silicon, and more than 3.25 per cent. total carbon, grey pigs produce white deposits. They are simply caused by the slow cooling of the high phosphorus and siliceous metals, which have a considerable latent heat of fusion. Once the cast has been poured, the risers as well as the thinner parts are not long in solidifying. The metal of the thicker parts remains in a liquid state, and purification—that is, the rising of the oxidised bodies contained in the metal—continues, and, as there is no longer

any exit by the solidified risers, forms the white deposits.

These defects are found only in castings poured in dry sand. The writer has never found white deposits in castings run in green sand. This is because, as a rule, large castings are not poured in this way and because the cooling of the metal is much more rapid than in dry-sand moulds, by counteracting the crystallisation of the graphite (en contrariant la cristallisation de graphite). Apart from this fact, the sand exercises no influence on the formation of deposits; indeed, the mould is never altered at any point.

Remedies.

If the construction of machines enabled castings of uniform thickness to be employed in each, the problem would be extremely simple; it would suffice to adjust the proportion of the essential ingredients according to the thickness—carbon,

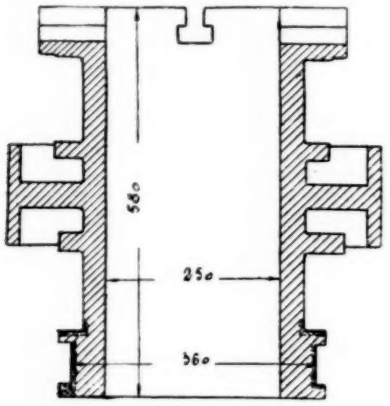

FIG. 4.

silicon, manganese, and phosphorus. But the greater number of castings are composed of thin sections in conjunction with thick sections. Under these conditions, if white deposits are to be avoided, pure pigs must be employed, and with the closest possible grain compatible with the finishing work required.

If a mixture containing less than 0.8 per cent. phosphorus, less than 2 per cent. Si, and less than 3.25 per cent. total C is employed, white deposits will never be found.

In the case of castings of uniform thickness, of 8 cm. (3.2 in.) minimum, which are not subject to any particular condition as regards strength, irons containing 1.5 per cent. phosphorus, but with a maximum of 3 per cent. total carbon, 1.5 per cent. of Si, and 0.50 per cent. of Mn may be used, with a view to economy. These grey pigs have a fairly close grain.

It generally happens that both small and large castings have to be included in one pouring. It is very difficult to reserve a special mixture for the former and another for the latter, because the precise time when a casting will be ready for pouring cannot be foreseen. In this case only one kind of metal is used, and it must answer perforce. Generally the ordinary foundry pig is used in the proportion of 50 to 65 per cent., the remainder being small scrap; it contains a minimum of 1.50 to 1.75 per cent. phosphorus, 2 to 2.25 per cent. Si, 0.50 to 0.75 per cent. Mn, and 3.5 per cent. total carbon. This pig, as already stated, produces white deposits when the metal is poured very hot, as it comes from the cupola in normal working. But if large castings of uniform thickness are required, this defect may be remedied in the following manner, which is, no doubt, merely a makeshift, but to which the writer thinks it well to draw attention. It is applicable to castings of a minimum weight of 1½ tons.

The metal, having been melted at a high temperature, is collected in a ladle of the necessary capacity. The skimming is done with the utmost care, and the bath is then covered with a good layer of fine powdered charcoal to preserve it from oxidation. The metal is left thus in the ladle for at least twenty minutes; that is, in the case of a ladle containing 5 tons it may be left for half an hour. During this interval the oxidised bodies in suspension in the metal will have time to rise to the surface. The pouring is then done as quickly as possible, the mould being provided with large risers, care being taken to keep the runner box well filled.

This method has one advantage—that of enabling a sound casting to be poured with a mediocre mixture. It has always proved successful with the writer, but with inexperienced persons it has the disadvantage of leaving a considerable portion of its success to chance. If the metal is too low in temperature on coming from the cupola, allowing it to stand is harmful, as it makes the metal pasty and will produce defects which are infinitely more serious than white deposits.

Practical Examples.

The writer thinks it well to close this study with a few practical examples of mixed pigs, in ordinary cupolas, working at neither excessively high nor too low pressure.

Pig Causing White Deposits.—(a) No. 3 English, Belgian Luxembourg, Grand Duchy of Luxembourg, Lorraine, Meurthe-et-Moselle, in the proportion of 50 to 65 per cent. and 50 to 35 per cent. of grey broken scrap.

(b) No. 3 of the same pigs in the proportion of 30 to 35 per cent., with 30 to 35 per cent. of No. 3 English, German, or Belgian hematite, and 30 to 35 per cent. grey broken scrap.

Pigs for Use to Prevent White Deposits.—(1) 50 to 60 per cent. of ordinary No. 7 foundry pig, 50 to 40 per cent. of grey iron scrap.

(2) 20 to 35 per cent. No. 4 malleable hematite, 30 to 35 per cent. ordinary No. 3 foundry pig, 40 to 30 per cent. grey iron scrap.

(3) 30 to 35 per cent. No. 3 hematite, 30 to 35 per cent. ordinary No. 5 to 7 foundry pig, 40 to 30 per cent. grey iron scrap.

(4) 50 per cent. No. 3 hematite, 50 per cent. grey iron scrap.

(5) 40 to 50 per cent. No. 3 hematite, 60 to 40 per cent. ingot mould scrap.

(6) 50 per cent. No. 3 foundry pig, 10 per cent. steel, and 40 per cent. grey iron scrap.

Close-grained Pigs for Large Castings.—(7) No. 3 hematite, 30 per cent. (or 20 per cent.); No. 5 foundry pig, 35 per cent. (or 50 per

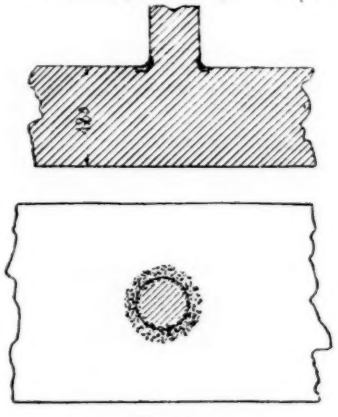

FIG. 5.

cent.); grey iron scrap, 20 per cent. (or 15 per cent.); basic steel, 10 per cent.; and spiegel, 5 per cent.

(8) No. 3 hematite, 25 per cent.; No. 5 foundry pig, 50 per cent.; white iron scrap, 20 per cent.; steel, 5 per cent.

FURTHER EXAMPLES.

Cast-iron Wheel.

In the construction of wheel lathes massive cast-iron wheels are used, on which cuts are made to test the tools before starting work.

Fig. 6 shows how the wheel was cast, with the position of the moulding box in broken lines, the parts hatched with broken lines showing the position of the white deposits.

The wheel was one metre (40 in.) in diameter and 150 mm. (6 in.) in thickness. The bars of the moulding box came down to 15 mm. (½ in.) from the casting. After casting, the proximity of

the bars caused the metal to cool more quickly, while in the rectangles formed by the bars its temperature remained high. Two days after removal from the sand it was found that the form of the moulding box was entirely outlined in a grey-blue tint of sound metal, while the interior of the rectangle was dark brown (see Fig. 6). By

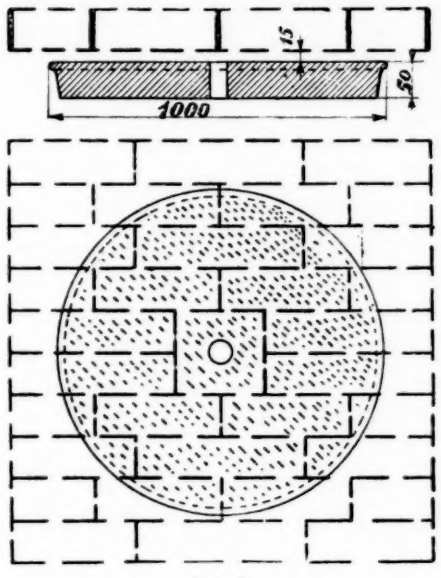

FIG. 6.

striking it with the hammer it was possible to remove layers of this deposit, resulting from a too siliceous metal cooled slowly.

Horizontal Lathe Frame.

In casting a horizontal lathe frame, as shown in Fig. 7, viewed from below, the inadequacy of the vent in a core produced "blowing," which continued for half an hour. During this time the feeders projected blobs of metal.

The pouring of the hot metal through the gate was continued until the boiling had ceased; after a quarter of an hour the smallest feeding head had solidified.

When the frame was stripped it was carefully examined, and not the slightest defect was dis-

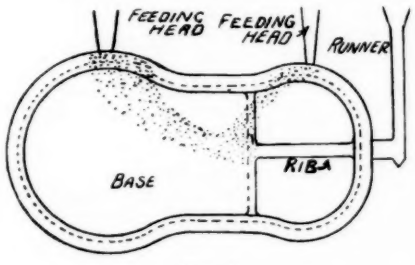

FIG. 7.

covered, unless it were a trail of white deposit in the form of crust along a line running from the gate to the feeding heads. Here, where the metal had been running so long, the mould had become very hot; cooling had been slow, and had allowed the oxidised material to spread itself over the surface.

Chemical Analysis of these Deposits.—Chemical analysis has given the following results:—SiO_2, 30.0; Fe_2O_3, 47.2; FeO, 16.7; Mn_3O_4, 2.65; CaO, 0.70; and not determined, 2.75 per cent.

The pig employed contained about 2.5 per cent. Si and 1.05 P.

FULLER'S UNITED ELECTRIC WORKS, LIMITED, of Chadwell Heath, Essex, have removed their Swansea depôt from Pier Street to more convenient premises at 51, Waterloo Street. Owing to the increase in the cost of lead, the company announce that the prices of all accumulators and lead cables were increased on January 1.

Some Notes on Steels for Case-Hardening.

BY C. H. S. T.

Steels used for case-hardening are well standardised, and it is not necessary to dwell upon them to any great extent. As the strength of case-hardened parts depends on the core toughness, too high carbon is to be avoided, as toughness becomes brittleness on hardening. In consequence, steels over 0.27 per cent. carbon are not recommended, and there is no low limit except as it affects the steel maker. There is, however, no advantage for machined parts to go below 0.15 per cent. carbon, as the metal tears under the cutting tool. The lower carbon steels are used in stamped and pressed cupped work and are satisfactorily case-hardened.

When alloying elements are added with the carbon to the steel in the melt, they act with the carbon to affect the carburising and hardening and various ways. The common alloying elements are manganese, chromium, tungsten, vanadium, molybdenum, silicon and nickel. It is generally conceded that the first five elements increase the rate of carbon penetration in carburising, and that silicon and nickel retard it. This should be the case, as the first five go more or less into solution in the steel and form double carbides with the iron carbides. The last two elements diffuse in the steel, but do not go into solution or unite with the carbides; they retain their individuality. Many instances have been shown where the rate of penetration does not occur as predicted. In general, it takes less time to obtain the same carbon penetration in carburising alloy steels than those not containing the alloys.

American practice formerly demanded that case-hardening steels contain no more than 0.35 per cent. manganese, though greater amounts of manganese had long been used in this country, and at the present time, there is a number of steels with a manganese content as high as 1.25 per cent.: even free-cutting screw stocks have as high as 0.90 per cent. manganese. Manganese is an aid to good machining, and the success of hardening manganese steels lies in the quenching bath. Gear manufacturers often use the rule that when the sum of the manganese and carbon percentages exceeds 1.00 per cent., quenching should be done in oil, though this only applies to intricate shapes. To some extent carbon and manganese affect the hardening in the same way, and a rule commonly accepted is that 0.07 per cent. manganese equals 0.01 per cent. carbon. Manganese will also lower the critical temperature of the steel.

Chromium, as an alloying agent, increases the hardness of steel and allows hardening to a greater depth than carbon alone, or other alloying agents. Chromium imparts to the steel a very fine grain structure, and as it is difficult to soften chromium steels by annealing such steels are not easy to machine. Chromium in steel raises the actual hardening temperature somewhat, and permits a wide temperature latitude without damaging the grain structure.

Nickel as an alloy increases the ability of steel to resist shock and fatigue and lowers the critical temperature, and nickel steels machine nearly as readily as non-alloy steels. Combinations of nickel and chromium give to the steel the best properties of each and overcome, to some extent, the machining difficulties found in chromium steels.

Tungsten, vanadium and molybdenum, as alloys, are seldom used alone, but in conjunction with the chromium and nickel-chrome alloys. The various actions are somewhat obscure and too lengthy to discuss here in detail. Suffice it to say that they act in several ways: either to assist the formation of the double carbides, thereby causing a fine-grained metal, or to act as cleansers in the steel by removing impurities.

The silicon content of a steel to be case-hardened should generally be under 0.25 per cent. for the reason that silicon decreases the speed of carburisation and also its depth of penetration. The phosphorus and sulphur, of course, should be as low as possible, because a case-hardening steel should be exceptionally free from impurities and segregations which cause weakness.

Some Aspects of Foundry Costing.

By John Spittal.

(*Continued from page* 35.)

The Cost of Experiments.

In looking over the various items mentioned under the heading of indirect labour, two of these may call for special remark, viz., experimental work and overtime allowances. Regarding experimental work, this falls naturally into two groups. (1) Experimental work undertaken by the firm with a view to adopting or improving upon certain designs of machinery or gear; and (2) experimental work carried out in the foundry for the purpose of arriving at correct methods of production under specific conditions.

Dealing with the first class of experiment, it is customary to reserve a definite sum in the annual accounts for the purpose mentioned to cover the estimated expenditure during the year. Obviously the cost of these experiments cannot be entered as a charge against the foundry output, therefore a specific order should be passed to the various shops, including the foundry, for every job of this description decided upon. The foundry, in common with other departments, would carry out the work in precisely the same manner as if the order was for an outside customer. The cost department would deal with the expenditure on the completion of each experiment, and also at the end of the financial year. It is probable that such work, when completed, may be transferred to a productive order and subsequently sold, and in that case the accountant would debit and credit the accounts affected accordingly.

The second class of experiment relating to methods of production is really a shop expense, and is consequently a direct charge against production. A point arises as to whether this expenditure should be charged against the work necessitating the experiment, or against the output generally, and in this connection it will be found the better way, it is thought, if each job is decided upon its own merits. If the experimenter is to acquire knowledge which other people possess, but is not known to the foundry concerned, then the foundry ought to bear the expense, and not the customer. When special work is carried out, however, to meet specific conditions laid down by the customer, and the ultimate benefit from the experiments is confined to that class of work, it is evidently a matter for mutual arrangement between the foundry and the customer. It is a melancholy reflection that castings are still being purchased by British engineers from the Continent, which could be produced in British foundries if only this spirit of reciprocity existed between the engineering and foundry interest. It also stirs our national feelings somewhat when it is realised that pig-iron required for making these castings is exported from our own shores.

Regarding the items for overtime allowances, it will be observed that these are shown separately, the total for the month being dealt with as a shop oncost charge. There are, of course, special instances, such as a breakdown repair job, where

Messrs...... *No.*.....

Specification..... *6th December*, 1924.

DETAILED APPROXIMATE EXPENDITURE IN PRODUCING ORDINARY CASTINGS IN GREENSAND.

Description. Cast Iron. G.S.	Weight, each	Total Weight.	Rate.	Metal Cost.	Direct Wages.		Oncosts.		Total Estimated Cost.
	Lbs.			£ s. d.	Class.	£ s. d.		£ s. d.	
Castings	112	1	5/–	5 0 0	Moulding ..	2 10 0	Melting ..	1 17 6	
					Closing ..	0 10 0	Dressing ..	2 0 0	
					Coremaking	0 15 0			
ONCOSTS:—									
A.—INDIRECT LABOUR:									
1. Supervision in Core Department								0 0 10	
2. Pasting and Storing Cores								0 4 2	
3. Core stove attendant								0 1 8	
4. Sand preparation in Core Department								0 1 8	
5. Supervision in Foundry								0 2 6	
6. General labouring in Foundry								0 8 4	
7. Electric cranemen								0 2 6	
8. Sand preparation								0 5 0	
9. Pouring								0 2 11	
10. Cleaning up and shop preparation								0 6 8	
11. Sundry work—test bars, experiments								0 1 3	
12. Storekeepers, watchmen, etc.								0 1 4	
13. Maintenance Staff; Plant and patterns								0 2 0	
B.—GENERAL STORES, ETC.:									
14. General Stores—Core Department								0 9 6	
15. Do. —Foundry..								0 3 0	
16. Coal dust and blackings								0 0 10	
17. Heating and ventilating works								0 0 5	
18. Fuel for Core stoves								0 4 2	
19. Sands								0 12 6	
C.—POWER COST								0 16 8	
D.—REPAIRS, RENEWALS AND MAINTENANCE								0 4 7	
E.—LOOSE TOOLS								0 5 0	
F.—FOUNDRY STAFF AND MANAGEMENT								0 6 8	
G.—DEFECTIVE PRODUCTS								0 6 8	
H.—ESTABLISHMENT CHARGES:									
Office staff and management									
Rates, taxes and insurances								1 16 8	
Depreciation									
Commercial oncosts, advertising, etc.									
Totals	1		£5 0 0	—	£3 15 0		£1 1 5 0		20 0 0
									=20/– per cwt.
PERCENTAGE OF TOTAL COST.									
METAL COST				25.0 %					
DIRECT WAGES				18.75%					
TOTAL INDIRECT WAGES				22.5 %					
ALL OTHER EXPENDITURE				33.75%					

CHART 2.

the circumstances justify the charge being made direct to the job. As a general rule, however, it is not a good principle to charge overtime allowances to the job on which the overtime is wrought when it has been occasioned by general pressure of work. These allowances often reach a formidable sum on a contract job, and in many cases it will be found that other work passing through the shops at the same time has been fortunate in almost completely escaping overtime. When the cost of this overtime is spread over the whole output, the net effect on the individual order is scarcely perceptible, but that could not be said if the whole cost was borne by one or two jobs. These would naturally come out much higher in cost than they should, and this might easily lead to a future inquiry being quoted, quite unnecessarily, at an enhanced price, resulting possibly in the loss of the order.

The next item under general shop charges is general stores. The consumption of these materials is another matter of some consequence, and a proper system of receipt, accommodation, and issue of all stores is a decided advantage in every shop. It is also one of the best preventives against waste and leakages, apart altogether from the benefit derived from a costing point of view. All the materials purchased for the foundry are suitably classified in the stores' ledger, the receipts and issue of materials being entered daily, an abstract of the issues being made at the end of the cost-week, and sent to the cost department. This abstract shows separately the materials used in the green sand, dry sand and core departments, so that the output from these departments would be debited accordingly.

The sixth item of costs deals with defective products, that frightful bugbear of every one having anything to do with foundries. It is an old saying amongst foundrymen that those foundries which make no bad castings never made a good one, and seeing that all foundries make good castings, there should be no timidity in dealing with the bad ones. Foundry wasters should be all sent forward to the dressing shop to be cleaned, and immediately passed on to the mortuary for the daily "post-mortem" examination. Some rejects, however, will not arrive at the dressing shop, as, for example, in the case of a "run-out." It has also been known, however, that other "rejects" mysteriously disappear, never to be recognised when they come to life again, as lively as ever, at the cupola spout the following afternoon. This method of handling bad castings is happily becoming less frequent, for every foundryman is aware that this is not playing the game in accordance with the recognised rules. It certainly does not help to reduce costs, and will never make any improvement on the output per man hour of good castings.

The foundry clerk should compile a daily list of moulds closed and cast, typed copies being sent to those concerned, including the foundry despatch office, which will then be on the outlook for the castings from the dressing shop. Castings which fail to come forward should, of course, be accounted for in the list of bad castings. As a general rule, these rejects are charged against the order to which they belong, an exception being made with a special casting being dealt with for the first time, in which case any wasters resulting from experiments to ascertain the proper method of gating, venting, size and position of risers, etc., are reckoned as a shop expense under the heading of experimental work. When the method of production is once established, the rejects are charged in the ordinary way against the job.

The castings rejected from the machine shops and test rooms have been already invoiced to the customer, or charged to the job, when they were despatched from the foundry as presumably good castings. On their return to the foundry the castings are examined and their full value credited to the customer or to the job, as the case may be, and debited to the defective products account. This account will, of course, be credited with the value of the metal in the scrapped castings, the balance, which represents the loss, being dealt with as a shop expense. There are three ways of charging this, viz.:—(I) When there is more than one moulding shop in the establishment the loss is borne by the particular shop in which the casting was made; (II) as a general foundry oncost spread over the combined outputs of the foundry department; and (III) as a special charge against each particular class of product to which the castings belong.

There may be points of advantage in any of these methods or in a combination of two of them, but a hard and fast rule cannot be laid down, as the conditions in one foundry may be quite different from the one across the street, where an entirely different class of work is produced.

Establishment Oncosts.

The seventh item, establishment oncosts, does not interest the foundry manager so much, as these are more or less standing charges over which he has no control. They include rent, rates, taxes, insurance, office management, etc.

Core Department.

In the core department the wages expended in making the cores are charged direct to the various jobs for which the cores are required. The total expenditure, including sand, fuel for drying stoves, general stores, indirect labour, depreciation, power and light, etc., is completed, and allocated on a percentage basis of the direct core-making wages.

Pattern Shop.

In some foundries the expenditure on patterns does not enter into the casting cost, but is an additional charge, similar to machining, etc. The output from the pattern shop is generally classified as follows:—(I) Special patterns made specially for customers' requirements are charged direct to the job; (II) new patterns required for a new design of product, being additional to existing standard products, are charged to capital expenditure; and (III) repairs and maintenance of standard patterns are charged to the foundry output.

The expenditure in the pattern shop is allocated on the productive wages basis, and the daily time records for the workmen will show to which of the three classes the work belongs. The items of oncost will include:—(I) All indirect work and non-productive labour in the shop; (II) accommodation and storage of patterns—wages of storeman and materials used in pattern stores; (III) timber and general pattern shop requisites; (IV) repairs and renewals of pattern shop tools; (V) pattern shop staff—foreman and assistants; (VI) proportion of power and light cost; and (VII) depreciation.

The only item here which may be specially referred to is timber. This should be requisitioned from the storekeeper in writing, giving the job for which the material is required. The timber cost is usually a fairly heavy one, and should be handled in a similar manner to the materials issued from the general stores.

Compiling Monthly Costs.

Assuming now that the machinery for collecting the various elements of cost is available, we may proceed to consider how the monthly costs are compiled. In some foundries it is necessary that the costs records be completed immediately after the castings are despatched, whilst, in other places, the returns can be completed at the close of the month and the output priced accordingly. When the costs are required immediately on despatch, and this condition applies to the bulk of foundry output, the following arrangement has given satisfactory results. The metal cost and the direct wages were always readily available, but the other items of expenditure were fixed at definite rates, and the oncosts charged partly on a wages basis and partly on a weight basis. The system provided for showing separately the sum charged as "oncost" against each order, and these were totalled monthly, taking into account, of course, the work and progress. At the close of the month the costs were completed in the usual way, and the actual cost of the month's output was obtained. As the estimated oncost rates were always fixed with a margin of safety, it invariably occurred that the sums charged as "oncosts" were in excess of the actual figures. The balance in hand was transferred to an appropriate account, and held in reserve for the slack month of the year, when the output was under normal. Briefly

stated, the position is that when one has plenty of work and the costs are consequently lower than usual, the benefits are not passed on to the orders executed during the busy months of the year, so that when the dull period comes along one is able to go more keenly into the market, or to venture in other directions for work to keep the men employed, for it is only when costs are kept normal, or under normal, that a period of trade depression can be survived. The general complaint to-day, however, is that instead of having, perhaps, three quiet months in the year, that unfortunate condition has extended to the whole twelve. It will be understood that the author is dealing with the subject under normal conditions.

How should the oncosts be allocated when completing the costs at the end of the month, so that each job bears its true proportion? It is principally on this point that the utility of foundry costing depends, and until a general and sympathetic movement is made in the foundry trade to put their costing systems on a correct basis they will continue getting along "somehow," in spite of the method by which costs are arrived at and prices arranged by many foundries at the present time. How often one finds it to be the case that special parts of a job, usually presenting some difficulty, are offered to outside jobbing foundries in the expectation that the rate quoted will be not more than 18s. per cwt., because the overhead rate of the castings runs out about that figure. It may be that one of the foundries offering for the work has a rough and ready method of costing, and takes on the job at 20s. per cwt., because their output for the past month was calculated to be a little lower than that figure, whilst, as to the actual fact, the position probably was that only 30 per cent. of the output cost this sum, the remainder coming out at rates varying from 14s. to 35s. per cwt. The casting taken at 20s. may possibly be costing 30s., but the estimating department is not aware of the fact, and when the end of the financial year comes round the lean results are generally attributed to "not having enough weight" in the output, or to someone not working as he should. There is perhaps some truth in both ideas, but had there been a correct method of costing and estimating for the work the results would have been much more satisfactory for all concerned. It may be argued that the work was taken at 20s. per cwt., because the foundry round the corner was prepared to take it up at that price if the first declined. It is for this reason that some definite step should be taken to adopt generally throughout the trade a revised method of costing, freed from academical and cumbersome details. Such a system is not beyond the capabilities of the average foundry accountant, and in this connection the author would strongly urge all engaged in this work to become thoroughly familiar with the practical work-a-day atmosphere of the foundry, to keep an eye on the technical developments of the industry and also keep in touch with the practical ideas of those actually on the moulding floor, so that the costing department may keep abreast of the times. This could not be better achieved than by regular attendance at the meetings of the Institute of British Foundrymen and a careful perusal of the trade journals.

Foundry Oncost Charges.

Dealing now with the allocation of the foundry oncosts, a careful study of the various items will convince one that in certain of these the services given have relation to the *weight* of the casting (*i.e.*, on a weight basis), whilst other items have a distinct connection with the time spent on the job, which for the present purpose we will call a *wages* basis. Reference has already been made to the melting costs and the dressing costs, on which it was advocated that the former are allocated on a weight basis and the latter on a wages basis. Again, take sand as an example. Foundrymen generally recognise, no doubt, that the more metal that goes into the making of a casting the greater quantity of sand will be required, therefore the allocation of this expenditure on a weight basis would seem to be the correct procedure. Then there is also the labour preparing the sand, to which the same argument would apply. As one examines the list there are other items, such as electric crane drivers, pouring, shop preparation, etc., so that the oncosts consequently separate themselves into these two sections referred to, *i.e.*, on a weight basis or a wages basis. When all the items have been extended to their respective columns they can be summarised so that there are at most only three calculations to make in allocating the oncosts:—

(I) At a certain rate per cwt.; (II) at a percentage on direct wages on each job, and (III) dealing exclusively with the core department, the expenditure being allocated as a percentage on the coremakers' wages on each job.

The effect of adopting these classified rates of oncost on the estimated price of the castings is apparent from the two examples in each of which the line A (Table I) shows the application of an overhead rate for oncosts, and the line B shows the classified rates. The figures are taken from the same month, only for obvious reasons they represent no firm or foundry in particular.

TABLE I.—*Effect of Classified Rates on Oncost.*

	Weight.	Metal Cost.	Direct Wages Cost.	Oncosts.	Total.	Per Cwt.
	T. C. Q. lb.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	
First Example.						
(A)	1 0 0 22	6 1 2	1 1 0	7 12 0	14 14 2	14/7
(B)	1 0 0 22	6 1 2	1 1 0	5 0 5	12 2 7	12/–
Second Example.						
(A)	2 15 0 10	16 10 6	16 18 3	20 12 6	54 1 3	19/8
(B)	2 15 0 10	16 10 6	16 18 3	55 14 0	89 2 9	32/5

In the first example, which represents plain heavy work without cores, it is seen that the flat oncost rate brings out the cost at 14s. 7d. per cwt., whilst the classified rates give the cost as 12s. per cwt. The ultimate effect would be that the foundry would be quoting for work 2s. 9d. per cwt. more than they could have done, but were not aware of the fact so far as the costs were concerned. This foundry, therefore, runs a serious risk of losing work they could possibly get and turn out at a profit.

In the second example, which deals with light and intricate castings involving a considerable amount of core work, it will be seen that the overhead rate brings out the cost as 19s. 8d. per cwt., as against 32s. 5d. per cwt. under the classified rates. The position here is the reverse of the first example, as the foundry would be basing their quotation for work at 19s. 8d., which was really costing 32s. 5d. per cwt. to produce, consequently they would, in all probability, get as much of this class of work as they felt inclined to take, but someone would be buying it from them at a price less than the cost of production. This foundry, then, must look around for castings having more "weight," in order to get the balance of costs adjusted, but the outstanding fact remains that customer A is paying something towards the loss incurred in producing the castings for customer B. Anything more unsatisfactory in the realm of costing can scarcely be imagined, and the time for putting our costing arrangements on a sound basis is long overdue.

Another point of interest where the classified rates are in operation is that the estimating department will generally be found in sympathy with a system of estimating where the oncosts are calculated on both weight and wages, as when only the one basis is used (whether weight alone or wages alone), and a mistake is made in underestimating either the weight of a casting, or the

time allowed for the job, the loss incurred in calculating the oncost is much greater.

Other trades have adopted with marked success what may be termed universal rules for costing their particular products, and it seems regrettable that the movement in this direction in the foundry trade is lacking of that energy usually displayed in other matters. The author was particularly interested in an article which appeared in THE FOUNDRY TRADE JOURNAL of November 13 last, entitled "German Method of Costing in Foundries." This article deals with a booklet which has been issued by the German Union of Iron Foundries, and which aims at providing a sound basis of costing for most of the important foundries in that country. There can be no doubt that the German foundrymen have been studying this question of foundry costs with extreme care, and they have apparently seen the necessity of adopting a definite system for all their foundries to work upon. They have even prepared calculating tables for estimating the cost of castings, and have separate tables for various districts where different economic conditions prevail. The method they set forth, however, is open to some criticism, especially in the manner in which they lump together the overhead charges for dry-sand and green-sand work, and one would conclude from a perusal of the system that the heavy cost of preparing dry-sand moulds is borne equally by the output of both green-sand and dry-sand castings, and also that the entire cost of the core making is distributed over all castings whether they involve core work or not. In any case, the German foundrymen have taken united action upon a matter of first importance so far as their commercial efficiency is concerned, and this action is bound to be of great assistance to them in so directing their energies that an increased and more profitable business will result.

In conclusion, the author has endeavoured to interest foundrymen in those matters that concern the commercial side of the foundry business, particularly in regard to foundry costing, and although he has not submitted a mass of detailed specimen forms, he trusts, nevertheless, that foundrymen will appreciate the necessity of the costing department in every foundry, and that each one will do what he can to assist, but do nothing to hinder its efficiency, for it is only by each department pulling together and putting in all their weight that the success we strive for can be achieved.

THE DISCUSSION.

MR. ELLIOT said he thanked Mr. Spittal for his very interesting Paper. With regard to the practice of a clerk going round the shop collecting particulars, he agreed with Mr. Spittal that a system of time cards as outlined in the Paper was much better. That system was, in his opinion, the most accurate and therefore the most satisfactory. He also agreed that the method of basing the oncost partly on a wages and partly on a weight basis was nearest the truth. Oncost was, of course, very much a matter of approximation. He thought that Mr. Spittal's Paper had given the meeting a general idea of the accountant's work in connection with a foundry, and that it would help to clear away the suspicion that the accountant was only there to find somebody out.

MR. AFFLECK, Branch President, said he had had some experience of the benefit of a costing system in foundries where there was a great variety of castings made. In the first instance in his experience that a costing system was applied in the foundry it was applied in a fairly elaborate manner. Practically every class of casting was dealt with in detail, and at regular intervals there was placed before him a series of figures relating to these castings. He found that while the ultimate cost came out at, say, about 35s. per cwt., some were as high as 70s., and others again as low as 25s. If one had not the actual cost before him, he might be inclined to quote on an average rate. They might get the job and have less money on it, but they would prevent someone else getting it who could do the job at, say, a moderate rate and yet not lose on it. Referring to costs, he said he had scarcely ever investigated a case of high cost where the moulder was to blame. It was rather some fault of the plant. The handling of the sand was an important item in costs, and he had seen some figures which brought out a rate of 20 per cent. of the cost being involved in the handling of sand. The large proportion of the cost which this item represented had been appreciated on the Continent, but he did not know to what extent it had been appreciated in this country. In one large foundry which he had visited on the Continent they had installed expensive plant with a view to lowering the cost of handling sand. When he saw that plant it was not working owing to some mechanical difficulty, but the installation of such plant showed that they appreciated the difficulty connected with this question. With regard to costs generally, he had found that the more detail they went into in getting out costs the more it would cost them to do so, and therefore the balance must be struck somewhere. So far as his experience went, they had started out with a very elaborate scheme, and when they had got a certain amount of information they contracted the scheme somewhat and then took only a certain number of classes. That, of course, was a compromise between a very costly system and a very simple system. To arrive at actual costs, however, he believed would greatly benefit the foundry trade, competition would be fair, and the engineering trade would benefit also.

Mr. Spittal was accorded a vote of thanks for his Paper.

Catalogues Received.

Cast-Iron Pipes.—The monthly stock list for January, issued by the Staveley Coal & Iron Company, Limited, Chesterfield, is now available.

Foundry Requisites.—William Olsen, Limited, of Cogan Street, Hull, have just issued a 40-page illustrated booklet, which details and prices the materials they handle. A well-arranged index is inset in such a way as to render searching a minimum of trouble.

Gauge Testing.—We have received from the Director of the National Physical Laboratory a copy of the laboratory test pamphlet on gauge testing which has just been revised. This pamphlet deals with the tests of various types of gauges and measuring apparatus usually to be found in inspection rooms and workshops. As far as possible limits of accuracy have been laid down for such gauges and instruments. If found to comply with these limits, of which there are sometimes two grades, the gauge or instrument is granted a Certificate and receives the Laboratory mark of approval, NP.

The pamphlet contains details of the measurements that can be made and of the fees charged, and copies may be obtained on application to the Director, National Physical Laboratory, Teddington.

Weighing Machines.—We have received from Messrs. W. & T. Avery, Limited, of Soho Foundry, Birmingham, a copy of their export catalogue, No. 400. It is of the type of publicity matter which one has become to associate with the name of Avery—that is—the best. In an introductory note, it is stated that "they are in a position to alter or amend apparatus to suit the customer's convenience." A demand which we once imposed was that the machine should be capable of weighing both in the metric system and British system, and that tickets should be stamped giving the weight in both systems. The object was that furnace calculations should be made for the sake of ease in the decimal system, and that it was also available for normal commercial purposes. We should like to see this system extended for use with cupolas and other types of furnaces.

The catalogue has been prepared on art paper; it is well illustrated and admirably indexed. Whilst we are aware that a special catalogue is available for testing machines, quite a number of representative apparatus are described and illustrated. Foundrymen should certainly make an effort to include this catalogue in their files.

PEASE & PARTNERS, LIMITED, have now taken over the Lackenby Iron Works, Grangetown, near Middlesbrough, of the Tees Furnace Company, Limited.

Testing Cast Iron for "Life."*

By Charles Cury, Engineer, E.S.F.

For the sake of clearness it seems desirable to give at the outset a brief summary of the manner in which it is here proposed to treat the question. After the origin of "life" tests has been touched upon, the various experiments carried out and the modifications in test-bars resulting from them will be mentioned. The effect of different factors inherent in the structure of the mould which are such as to impair the results will then be examined. Finally, the present position of the question as indicated by these data will be described, and something will be said as to the conditions which such a test-bar may reasonably be required to fulfil.

Definition of "Life."

The term "coulabilité," or "life," originated by M. A. Portevin, is used in a perfectly definite sense in foundry work; it is the property which a metal possesses of filling a mould more or less completely. It is evident, of course, that the term "fluidity," which was long used to designate this property of filling a mould, is inappropriate, since fluidity is a physical property affecting only the metal itself, whereas "life" has to do with both the metal and the mould.

Without dwelling further upon this point, it is obvious that it is of the highest importance to the founder that he should be in a position to estimate the life of his metal quantitatively, and at any moment of the melting operation.

Perhaps there is no technical question which has given rise to so many discussions between master and workman in modern foundry practice as that of knowing whether a liquid metal is or is not fit for casting a mould or a given series of moulds.

The workman is prone to attribute the cause of a waster to cold metal, and in the majority of cases, failing proof, it has to be admitted that he may be right.

Now, what means has the founder at his disposal of estimating a property so complex as life? None, in fact, exists, for even although a pyrometer specially constructed for measuring high temperatures may furnish him with some information, it is still inadequate, since it takes no account of the numerous factors affecting the metal's life. Moreover, scientific apparatus, however accurate, cannot be regarded as sure guides for ordinary use; they are a means of control and not of measurement. It is, therefore, important for the founder to have a method enabling him to determine rapidly and as simply as possible the degree of "life" of his metal, and constituting, as it were, a "mediator" between master and operator. This will be one of the parts played by the life test-bar (we say "one of the parts," for it will presently be seen that its field of activity may be considerably extended).

Viscosity Tests.

It would appear that the first experimenters likened the fluidity of molten metals to the viscosity of certain liquids, and, basing themselves upon the experiments made, they desired to apply the principle to fused metal. The simplest method of measuring the viscosity consisted in allowing the liquid to run through a narrow opening for a fixed period and then measuring the volume discharged. The diameter of the tube and the density of the liquid being therefore known, the viscosity could be calculated quantitatively. The apparatus thus designed is the viscometer. Evidently such a method could not be applied to metals; it was improved by the Swede Arpi, who designed a graphite reservoir and a tube of fused silica, very narrow at its extremity and dipping into a small graphite crucible. This part of the apparatus was enclosed in an electric furnace so as to keep the temperature constant. Instead of allowing the liquid to flow out by gravity, it was drawn off by suction and the time required by the liquid to rise from one mark to another was noted. Thus designed, the apparatus gave, it appears, very interesting results in respect to metals with a low melting point. A third method, also applicable to relatively low temperatures, called the "wire spool method," consisted in suspending at the end of a wire fixed to a support a weight in the form of a flat disc, causing it to perform a certain number of revolutions and then releasing it. The untwisting of the wire carried the mass beyond the dead centre, and the apparatus finally came to rest. On conducting the experiment in the open air it was found that the disc required a certain time to come to a standstill; on causing it to revolve in water the disc stopped sooner, and in glycerine still sooner. The viscosity of the liquids could then be measured by comparison.

Obviously, all these are laboratory experiments which could not be applied in practice to ferrous alloys. It was therefore necessary to find a "tell-tale" test-bar capable of informing the founder as to the fluidity or, rather, the "life" of his metal. It seems that the origin of these tests by the casting of "tell-tales" is to be attributed to the American, Thomas D. West, who, about the year 1898, made fluidity tests by using a wedge-shaped test-bar about 25 cms. long. This test-bar was cast either upright or flat. It constituted a first trial.

At the International Foundrymen's Congress (Paris) in 1923 the Brousseval Works exhibited an identical, but much longer (1.20 m.), test-bar which they are at present using, and which indicates the "life" of the metal as well as the texture corresponding to the different thicknesses and also the amount of shrinkage. Further particulars as to this test-bar would be welcomed, especially with regard to the method of casting and other points of importance.

THE FOUNDRY TRADE JOURNAL of February 2, 1922, contained a very interesting lecture by Professor C. H. Desch to an Institute of British Foundrymen Branch meeting at Sheffield, in which reference is made to the tests carried out in 1920 at the University of Kioto by two Japanese experimenters. They had the idea of replacing the wedged-shaped rule by a spiral test-bar of constant section. The published data regarding this test-bar are very vague. According to correspondence exchanged between Mons. Ronceray and Dr. Desch, the section was 1 sq. cm.; this is the only precise indication available. As to the mould itself: "It was provided with a gate, and a riser in the centre; it was made with fine sand, carefully dried and then brought to a certain given temperature, the same for all the experiments. The liquid metal was poured into the reservoir, and when the latter was full a cast-iron plug was removed and the metal allowed to run into the mould."

Continental Standard Established.

Taking up the idea of these Japanese, M. Remy, the well-known Liège foundryman, recently evolved a test-bar which has now been adopted by the Association d'Etudes de la Malléable (Malleable Cast Iron Research Association). This test-bar is constituted by a helically-wound cylindrical 6-mm. rod, on which gauge marks are fixed at regular intervals (every 50 mm.). It is provided with a gate placed at the side of the mould and a reservoir placed below the feed and beneath the plane of the spiral. The principle consists in letting the liquid metal flow into the test-bar through a strickled aperture obtained by means of a sand core and at a level which is practically constant, this latter condition being secured by means of a very wide lost head, so that the surface of the liquid metal undergoes but little fluctuation due to irregularities in pouring. The purpose of the reservoir placed at the drag is to prevent the liquid metal from penetrating into the spiral before the feed-box is completely filled, so as always to maintain the same rate of flow. The dimensions of this reservoir were determined accordingly.

* Translation of a Paper read before the Association Technique de Fonderie, November 6, 1924.

The Author's Experiments.

The Association d'Etudes de la Malléable having presented a model of this test-bar to the Ecole Supérieure de Fonderie (French Foundry High School), an opportunity was thus provided for making a special study of this very interesting question and selecting it as the subject of a Paper.

Starting then with the Remy test-bar, which embodied the most rational conception of what had hitherto been done, the aim in view was to investigate the possible influence of different factors upon the results obtained, in particular the inclination of the moulding box at the moment of pouring—which, it seemed, must play a certain part—as well as the effect of certain factors affecting the mould alone, such as dampness of the sand, air compression at the extremity of the spiral, etc.

At the outset, however, and in agreement with M. Remy, it appeared desirable to modify the circular section of the test-bar, which presented difficulties in moulding, and to substitute a triangular section with the base above, so as to form the joint, and with a slight curve at the opposite apex. The dimensions were then calculated so that the new section should be practically equal to the former section, thus retaining the same flow.

Early Troubles.

The first experiments made in this way on identical moulds, squeezed by a pressure moulding machine with the same sand and cast green horizontally from the same ladleful of metal, showed fairly perceptible differences in the length of the test-bars obtained. Clearly this was a capital point which had to be cleared up as soon as possible, seeing that it formed the basis of the experiments. These were resumed systematically, therefore, and endeavours were made to eliminate the different factors which seemed likely to falsify the results, and it was then found that the errors were, for the most part, due to the core serving as feeding gate for the metal. This gate is, in fact, only 5 mm. in diameter. It happens, however, that with such a small diameter the slightest defect in the diameter of the inlet, either owing to a seam or a slight fracture of the sand, has the effect of considerably modifying the results. Thus, it was observed that in the case of a gate reduced from 5 to 4 mm. approximately the divergence in the length of the test-bars obtained was something like four divisions, which is enormous in view of the fact that with high phosphorus iron cast very hot twelve divisions are hardly ever exceeded. This divergence therefore represents an error of about 30 per cent.

This was clearly a difficulty to be solved. Its solution, moreover, appeared quite simple theoretically; namely, to employ cores with an accurate bore. In practice, however, this is difficult, and it is to be feared that the test-bar is here subject to conditions which render it impossible to regard it as being at once simple and suitable for ordinary use in foundry work, in which absolute precision is not always realised. It therefore appeared desirable to discover to what extent this 5 mm. gate could be enlarged, without injuring, of course, the qualities of the test-bar.

First Modifications.

It was found, in addition, that running for the side the mould had the drawback of requiring the moulding-box to be perfectly horizontal, a slight inclination entirely falsifying the results. Generally speaking, it was observed that the inclination of the mould reduced the length of the spiral; but this is sufficiently explained by the fact that the metal, having reached the lowest point, is obliged to overcome a resistance in order to rise again.

In order to remedy these two drawbacks it was thought desirable, with the advice of M. Ronceray and with his collaboration, to make the following modifications in the original test-bar.

In the first place, the feeding gate was placed at the centre of the spiral, which in fact gives a double advantage: in the first place, the effect of the mould's inclination at the moment of casting is eliminated, or at least greatly minimised; in the second place, the running from the centre enables the dimensions of the moulding-box employed to be reduced.

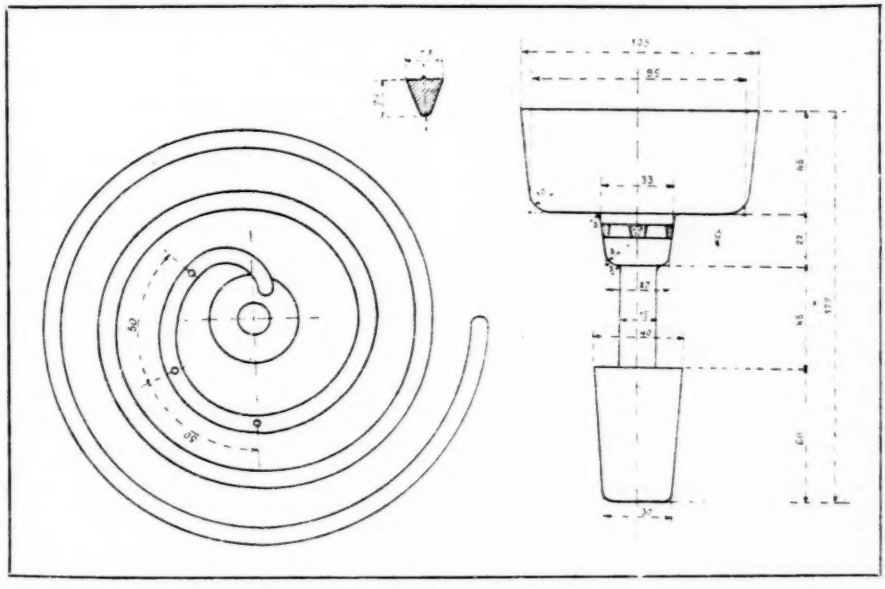

FIG. 1.—METRIC DIMENSIONS AND METHOD OF RUNNING "LIFE" TEST-BARS.

The possibility of enlarging the feeding gate was then considered, and a filter of ordinary construction with three 6 mm. holes was used and placed in the feed-box. Experiments were then made by stopping successively one and two holes of the filter, and it was found that, starting with a certain section of the gate, distinctly greater than the section of the spiral, the increase of this section had no longer any appreciable influence on the results obtained. That is to say, that in proportion as the flow of the feeding gate is increased, the path of the metal through the spiral likewise increases. Thus, with a 6 mm. gate, with the same metal, and, moreover, under identical conditions, a longer test-bar is obtained than with a 5 mm. gate. An idea has already been given of the difference of size in the test-bar represented by this difference of 1 mm. If the flow is further increased it is observed that the length of the test-bars obtained no longer varies in the same proportions. The difference is less noticeable, and if only one of the holes in the 3-hole filter is stopped it is found that the length of the test-bars no longer varies at all, the results

being the same with two and three holes, the conditions governing the experiments being, of course, identical.

Besides the advantage presented by the enlargement of the feeding gate from the point of view of eliminating possible errors due to defective strickling of the cores, this enlargement has another point of interest. It was seen, in fact, that owing to the greater flow the metal travelled further into the test-bar. This increased path enables the metal's greater or less degree of "life" to be more readily determined. The greater, in fact, the scale of comparison the more easily can the results be interpreted. In casting a very hot high-phosphorus metal with the original test-bar, no more than twelve divisions were ever obtained. With the test-bar modified as described, nineteen, and even twenty, divisions were reached. It is even possible that certain metals may be capable of completely filling the spiral, which at present is composed of only 22 divisions. It must be stated that hitherto this has never occurred, but if it did nothing would be easier than to lengthen the test-bar. This is another advantage of running from the centre.

The function performed by the reservoir in the Remy test-bar has already been shown. This function is no longer the same in the modified test-bar. In view of the larger gate it will be seen that a reservoir of much too large dimensions would have been necessary; so in the modified test-bar the purpose of the reservoir is merely to receive the first metal. There is no inconvenience, therefore, in reducing its dimensions, and its depth was, in fact, reduced from 80 to 60 mm. Experiments made with reservoirs varying in capacity show clearly that, while the path of the metal is slightly increased in proportion as the capacity of the reservoir is diminished, the results nevertheless remain constant for the same approximate capacity. The drawing (Fig. 1) shown gives the dimensions of the test-bar as described above.

Thus designed, the test-bar has hitherto given satisfactory results. Its final adjustment, however, has not yet been completed, and apologies must be tendered for submitting this research in an imperfect state. It must, however, be observed that M. Ronceray, as President of the Lectures Committee, is not altogether without blame for not having granted a longer period in which to advance further the long series of experiments necessitated by the work.

One of the essential points is to secure the total elimination of the possible causes of error arising from the method of casting. It is necessary, in fact, that this test-bar shall not merely be very simple to mould, as already stated, but that it shall be capable of being cast by anyone without there being any divergence in the results. It is therefore desirable to study the questions of depth and speed in casting.

Speed of Casting.

For this purpose the series of experiments which, for want of time, it had been impossible to carry further at the Ecole, was recently resumed, and it was observed that if the cast is poured direct on the filter core the length of the test-bar obtained is always longer than if the cast is poured in the runner-box beside the filter. This is explained, moreover, by the fact that the height of the liquid column is increased, and this defect was easily remedied by pouring in a second runner basin beside the existing one.

As regards the question of speed in casting, this may exercise an influence within wide limits; that is to say, that if, for example, a test-bar is cast very slowly and with a thin runner, and another at the same time, filling the runner basin rapidly, in this case divergences may be obtained of about three divisions, which is obviously too much. But in casting normally no appreciable divergence has so far been observed. (By "no appreciable divergence" is meant a difference not exceeding one division, for it must not be forgotten that this test-bar is not a scientific apparatus, and consequently absolute accuracy cannot be expected from it.)

Such are the practical results obtained, but it will be of interest to state clearly their reasons and give a logical explanation in support of each of them. This will be the object of future investigation.

The third portion of this Paper relates to the first results ascertained with regard to certain external influences likely to affect the life of the metal. These are the factors arising from the construction of the mould itself.

These experiments were carried out in the first place with the Remy test-bar, care being taken to employ an accurately strickled core, the moulding-boxes being placed level. They were then checked a second time with the modified test-bar.

Air Compression at Extremity of Spiral.

It was thought that the gases, being compressed at the extremity of the spiral during the casting, might offer a certain resistance to the path of the metal. Experiment showed that this was not so, and that in sand moulds vent-holes from 2 mm. to 10 mm. and more in diameter did not in any way affect the results. This is no doubt explained by the permeability of the sand, but probably the effect would not be the same if chills were used. It is hoped soon to reach a definite conclusion on this point.

Influence of Humidity in Sand.

Curiously enough, humidity in the sand also exercises but little effect. It might be expected, however, that a dry sand would give a much greater length of spiral than that obtained when using damp sand. In reality, experiments made with a very dry sand, the humidity of which did not exceed 2 per cent., gave very nearly the same lengths of test-bars as those obtained with sand the humidity of which was 7 per cent.—that is to say, very damp. In fact, a mould dried superficially with a blow-lamp and cast along with another made with damp sand showed barely one division of difference.

Effect of Coating Surface of Mould.

During experiments recently made by the author at the Rosières Foundries it was observed that plumbago sprinkled over the surface of a mould had a tendency to augment the life of the metal. It appears that this process was adopted for thin castings difficult to make. On the experiments being resumed systematically the fact was confirmed. It was found that the test-bars obtained with moulds coated with plumbago were invariably at least two divisions longer as compared with the others. There is certainly a very interesting study to be made on this property of blackings, and it would seem that the "life" test-bar must prove of great service for the purpose.

When the work of adjustment has been completed it will be desirable to endeavour to make certain improvements for the purpose of simplifying the work and fulfilling as far as possible the two essential requirements of such a test-bar, viz., that it shall be at once simple and practical, so that its use may become general in foundry work.

With this purpose in view, and anticipating to some extent the programme outlined, the author made a chill mould a few days ago. At first sight, indeed, the idea of chill casting appears practicable for this test-bar, seeing that it is a question of comparative tests, and that, moreover, the factor of humidity in the sand may now be regarded as negligible.

The few experiments hitherto carried out in this connection were too hurried, and clearly do not enable any conclusion to be drawn from them. They, however, enabled the conditions of adjusting the chill to be studied for the greater part, but we have certainly here a new field of investigation to which the studies of foundrymen who are interested in it may well be directed.

M. Ronceray also suggested casting in an oil sand core, which might be prepared beforehand and would thus be always available for the use of the founder. This seems an excellent idea, and its solution should be practically studied.

Possibly there may be other methods available, and the Association Technique de Fonderie will certainly be very glad to receive all suggestions that may be submitted to it.

To sum up, although not a scientific apparatus, this test-bar should give the founder sufficiently accurate particulars as to the life of his metal; it will also have the great advantage of being

within the scope of workmen, who will regard it as a practical means—not involving any scientific knowledge—of ensuring that their castings will turn out well. A particular example which the author recently witnessed in a large foundry may here be mentioned. To make a success of certain castings a test-bar of five divisions was regarded as sufficient. It was observed, however, that the first metal, which it had been customary to discard and which gave exactly this number of divisions, was very suitable for these castings. Since then the first charge has not been discarded, except, of course, when the test-bar indicated a colder metal.

The "life" test-bar, therefore, may eventually serve to regulate the consumption of coke and to diminish it, if necessary, when it has been found that certain castings can be successfully executed with a less hot metal.

In a general sense, moreover, it will prove a valuable instrument in the hands of the founder, enabling him to control the apparatus of fusion at every stage of the casting.

Finally, when it shall have rendered possible the interesting study of the influence which the chemical elements entering into the composition of a metal may exercise upon its life, it will constitute a guide to the founder regarding the uniformity of the charges. It may be said that this question, so important in foundry work, has hitherto been almost neglected for want of means enabling systematic experiments to be carried out. We have had to rest satisfied with hypotheses, no definite information being derivable from the material facts. Last year M. A. Portevin stated what the Science of Founding must consist of: "Experimental results and observations analysed methodically and condensed in the form of rules or laws." As the test-bar ought to be capable of furnishing the practical observations, it will be the part of the members of the Association Technique in future to endeavour to deduce from them the general laws of "life" which govern the alloys employed in foundry work.

A New Chrome-nickel Alloy.

A particularly interesting product is the "Emperor" chrome-nickel alloy which contains a high percentage of nickel, and for many special purposes, such as hardening boxes and pots, annealing pans, pyrometer tubes, crucibles for the melting of metals, and glass moulds, to name a few only, is claimed to be much superior to cast iron or steel. It has about the same hardness as cast iron, but possesses approximately twice the tensile strength whilst being easily machined and requiring no special tools.

Perhaps its most striking property, however, is that it does not scale, warp, or crack, and has a long life with these desirable properties even at permanent working temperatures of 955—980 deg. C., whilst at these figures also the tensile strength is the very high one of 13.3 tons per sq. in. Consequently annealing or other boxes made of this chrome-nickel alloy need be only about half the weight and thickness of cast iron or steel since no allowance has to be made for scaling, thus increasing the furnace capacity and reducing the relative cost per box. An interesting property also because of this absence of scaling is that boxes can be marked permanently with chalk or white paint, and further, also, both boxes and contents may be quenched in water on being withdrawn from the furnace.

This "Emperor" alloy is a production of Messrs. Sutcliffe, Speakman & Company, Limited, Leigh (Lancs), and they claim that for many conditions, in spite of higher initial cost, it is cheaper in the long run than iron or steel, since the average working life is about 5,000 hours instead of 200. One extensive use is in the form of standard tubes 1 in. bore and 1¼ in. outside diameter in lengths from 12 in. to 66 in. Further, also, another important field is the chemical industries, since it possesses the resistance to acids characteristic of many nickel alloys, valuable for chemical stills, retorts and other vessels, and another outlet because of its non-corrodibility is in the manufacture of steam fittings for very high steam pressures and temperatures of superheat.

Centrifugally-Cast Pipes.*

A new process for making cast-iron pipe centrifugally has been developed in the United States. It is known as the Henry-Weitling-Peake process, and is reported to be in successful operation at one or two American foundries.

The new method claims to have solved the problem of providing a satisfactory process for making cast-iron pipe in a rotating permanent metal mould, and yet one producing directly a soft grey-iron casting. It thus aims to eliminate the necessity for the annealing or heat-treatment of the casting after it leaves the mould. A simple machine is used. The entire molten metal charge is poured into a permanent mould, which is permanently mounted in the machine. The bell core also is permanent, being formed of solid pieces of gas carbon. This material was first tried as a lining for the mould itself.

The actual present practice of the new process involves the employment of liquid mercury and mercury vapour. The vapour is admitted to and withdrawn from an annular chamber in a double-walled rotatory structure (the inner wall constituting the mould) by way of a single combined inlet and outlet. The vapour is in a closed system including the annular chambers, and its pressure in each machine is modified by different amounts at different times during each casting operation. High-pressure, *i.e.*, high-temperature, vapour needed to be drawn at a particular moment from one machine is passed on to another machine needing at that same moment to have its vapour-blanket increased in pressure and temperature. For a battery of three to five machines about 100 lbs. of mercury, costing 80 cents (say 3s. 6d.) per lb. is needed. This mercury is a permanent installation on the basis that none of it should be lost. It is simply first vaporised, then condensed, then vaporised, etc., in different parts of the closed system.

These things are accomplished automatically by Sarco regulators. In each machine the metal mould is brought to a temperature of about 480 deg. Cent. just before the molten charge is admitted. As the mould approaches thermal equilibrium with the molten metal, the superheated vapour is passed on for use elsewhere in the system, as explained. The pressure of the vapour is so relieved that the molten metal gradually sets sufficiently to permit the extraction of the casting from the machine. When the casting has reached the state of rigidity just indicated, the pressure of the mould's vapour-blanket, and consequently the temperature of the mould, are watched so that the casting may not further cool during the short time required to slide it out of the machine to the point where pro-eutectoid cementite commences to form. Thus the pipe casting is abstracted, under the process, before its contact with the mould can result in chilling any part of the casting through the propagation of combined carbon. As soon as a machine is freed of a casting the vapour-blanket of its mould is once more subjected to pressure modification and is gradually brought to the correct temperature for receiving another charge of molten metal.

The principal source of heat supply to the walls of the mould is the molten metal which is being formed into the casting, and practically all the heat for maintaining a supply of mercury in the vapour form is furnished by the casting machines themselves. An external source of heat supply as well as heat rejection is desirable; but only a small one, it is said, is required and to act as a heat balancer.

THE COUNCIL of the Hungarian-British Chamber of Commerce, Budapest, announce that the new Hungarian Customs-Tariff on imports came into operation on January 1. Furthermore, all import-restrictions have been abolished, with the exception of such goods which have to be considered by International Treaties or which may interfere with the articles treated as State Monopolies. Likewise all export licence fees have been abolished, as also have all export restrictions excepting for articles coming under the above-mentioned categories, and raw-rubber, residues of non-precious metals, and ferrous, non-ferrous, and alloy scrap.

* Based upon an article in "The Iron Age."

XUM

Manufacture and Uses of Stainless Iron.*

By H. S. Primrose.

The method of making mild stainless steel in the past has been to melt mild-steel scrap in an electric furnace, and to introduce the chromium by adding ferro-chrome to the molten steel. As stainless iron contains about 0.10 per cent. and under of carbon, the ferro-chrome used has to be practically free from carbon, and as this alloy free from carbon is very costly, the resulting alloy is also expensive.

Quite recently a new process has been evolved whereby mild stainless steel can be produced more cheaply. This process, which is known as the Hamilton-Evans process, commences by melting the mild-steel scrap in the usual way, in an electric furnace such as the Héroult type. The slag is then poured off, and a slag known as the reception slag is introduced on to the bath of molten steel. When this slag is in a suitable condition, chrome ore intimately mixed with ferro-silicon is thrown on to this slag. The entire body of the ore with all its refractory components is fused, and the chromium oxide, iron oxide and manganese oxide are reduced by the action of the silicon in the ferro-silicon. The chromium and other metals so formed descend into the molten metal while the other components of the ore are retained in the slag. The silica resulting from the oxidation of the silicon combines with the lime in the slag, and the basic lining is thus protected from excessive corrosion while the resulting slag, after reduction has taken place, acts as a refining agent for the molten metal.

In the preparation of the raw materials for making mild stainless steel by the Hamilton-Evans process, it is necessary, in order that the minimum quantity of slag may be produced, that the chrome ore should be as rich as possible in chromic oxide and iron oxide. The ore should be crushed down preferably to about 20 mesh, and all coal, coke and other carbonaceous matter must be removed. The ferro-silicon used for reducing the ore may be of any composition, but the richer this material is in silicon, the better it is for working. It is necessary to use ferro-silicon free from carbon in order to produce the softest mild stainless steel, as carbon cannot be separated or refined out. The ferro-silicon should be broken down to about the same degree of fineness as the chrome ore which it is required to reduce. In preparing the mixture of chrome ore and ferro-silicon, the analysis of the ore must be known, as it is advantageous to adjust the proportion of iron oxide and chromic oxide.

The following chemical reactions take place during the process:—

$2\ Cr_2O_3$	$+3\ Si$	$=4\ Cr$	$+3\ SiO_2$	+exo-thermic calories
304.8	84	208.8		
$2FeO$	$+\ Si$	$=2\ Fe$	$+SiO_2$	+exo-thermic calories
144	28	112		
$2\ MnO$	$+\ Si$	$=2Mn$	$+SiO_2$	+exo-thermic calories
142	28	110		

CaO	inert	No chemical reaction.
Al_2O_3	inert	
MgO	inert	
SiO_2	neutral	

The usual analysis of the chrome ore used is as follows:—

Cr_2O_3	50.34
FeO	22.33
MnO	0.40
SiO_2	4.20—neutral
Al_2O_3	6.40—inert
MgO	15.70—inert
CaO	0.63—inert
	100.00

An efficiency of 60 to 70 per cent. of the silicon in reducing the oxides is found, and the balance of the silicon is spent in the adjustment of the complex silicate reactions. About 25 per cent. of the total chromium oxide is left unreduced in the slag as otherwise the slag will become too corrosive for the furnace lining. The slag is then in a condition for refining the resulting mild stainless steel. If facilities for preheating the mixture before adding to the slag are available, this greatly accelerates the reducing operation.

In the actual working of the process, the furnace is charged with the mild-steel scrap together with the necessary amount of limestone, ore, etc., to melt and purify it. The first slag formed in this melting is completely removed to eliminate the oxidised impurities, which otherwise would be reduced and passed back into the steel. The reception slag of limestone, flour-spar, mill-scale and chrome ore will then have to be added to the molten metal.

The composition of this reception slag is determined by the following considerations: (1) There must be sufficient lime present to maintain basic conditions throughout the reaction, so that the acid product SiO_2 may not predominate, with consequent corrosion of the furnace lining. Moreover, immediately acid conditions occur the efficiency of silicon as a reducing agent is diminished. (2) Its mass must be sufficient to enable enough heat to be stored to ensure that, with the exothermic heat resulting from the oxidation of the silicon contained in the mixture the ore will be melted, the necessary oxides reduced, and by gravity the metals be separated from the molten slag. (3) There must be sufficient iron oxide to ensure that oxidising conditions are maintained during the melting.

As soon as the reception slag has all been added, heat is applied by electric current through the electrodes of the electric furnace until this reception slag is brought to a molten condition. When the temperature is sufficiently high to effect reduction, the ferro-silicon and chrome ore which have been ground and mixed together, are gradually added to the molten steel. The reaction between the oxides of the metal and the silicon is exothermic, and consequently within a few minutes after the completion of the addition of the chrome ore and silicon, the reduction of the oxides will be complete, and the reduced metals chromium and iron will have entered the molten mass of steel beneath the slag. The resulting product will be mild stainless steel containing approximately 12 per cent. chromium, and it is desirable to continue the application of heat for a short time to refine the resulting metal. After the oxidation of silicon has occurred, it is necessary to apply heat in order that a slag may be maintained in a molten condition for the purpose of refining, and that the necessary casting temperature may be adjusted. In order that the heat may be supplied as above stated, the voltage must be high enough entirely to obviate the necessity of immersing the electrodes in the slag. If the electrodes are allowed to dip into the slag, the silicates already formed may be reduced to silicon and in consequence both carbon and silicon will be conveyed into the steel, and there is a risk of adding carbon to the molten bath.

Cost of Making Mild Stainless Steel.

The future of commercial development and wide engineering application undoubtedly lies with the low-carbon alloys containing chromium. The great hindrance hitherto to the rapid progress of commercial expansion, however, has been the high cost of production of such steel. With the Hamilton-Evans process using chrome ore and ferro-silicon, which are both comparatively cheap and easily obtainable commodities, this direct process puts an entirely different commercial phase on the rustless industry.

The cost of producing mild stainless steel in ingot form by the ferro-chrome process is about £65 per ton, but by the Hamilton-Evans process ingots are made at £30 per ton, which more than halves the first cost of the metal.

Consequently, such a process enables the production of high-chromium steels at comparatively low cost, thus ensuring the wide and extended use which they justly deserve.

* Abstract of a Paper read, December 19, at a meeting of the Manchester Association of Engineers.

Mild stainless steel is a steel containing from 11 to 14 per cent. chromium, with 0.1 per cent. carbon and under, the other constituents, silicon, sulphur, phosphorus and manganese, being all more or less in normal percentages. The chief effect of chromium may be summarised as follows: (1) It lowers the carbon content of the eutectoid proportionately to the chromium content, so that with 12 per cent. chromium the carbon content of the eutectoid is lowered to a third of the normal. (2) It raises the temperature at which the transformation points occur in the steel. (3) It diminishes the rate of carbon diffusion in the steel.

Owing to the first effect, a small amount of carbon exerts great influence in chromium steel. Carbon in the presence of from 12 to 14 per cent. of chromium has about three times the hardening effect of similar amounts of carbon in a plain steel. Owing to the second effect, the quenching and tempering temperatures have to be higher than in the case of ordinary steel. The third effect explains the air-hardening properties of this steel, and also its capability of retaining strength at high temperatures. Also, owing to this effect, it can be readily seen that by variation of the carbon content with different quenching and tempering temperatures, a very great variety of physical properties can be obtained with the same chromium content. This fact makes high-chromium steels applicable to most purposes where steel can be used.

Physical Properties.

The physical properties obtained from mild stainless steel in the annealed condition, and also in the hardened and tempered state, cover a very wide range. This will be seen from the following Table I, which shows the physical properties. These tests were made on "as rolled" and "annealed" bars quenched from 950 deg. C. in oil and tempered at various temperatures. Up to 500 deg. C. there is little or no change or reduction in the tensile strength, while there is an increase in ductility due to the relief of stresses set up during hardening. Between 500 deg. C. and 600 deg. C. the tensile strength falls off quickly, while from 600 deg. C. to about 750 deg. C. it falls slowly and steadily.

TABLE I.—*Tests of Tempered Bars.*

Tempered at Deg.C	Yield point	Tensile strength	Elongation	Reduction of area	Izod impact	Brinell hardn's
	Tons per sq. in.	Tons per sq. in.	Per cent.	Per cent.	Foot-lbs.	Kg. per sq.mm.
200	66.5	73.0	12.0	37.5	35	340
300	66.0	72.5	12.5	37.0	39	332
400	65.5	72.3	16.0	50.0	38	332
500	59.0	72.5	18.0	52.0	36	240
600	38.0	48.0	22.5	62.0	66	235
700	31.0	41.0	27.0	66.0	80	192
750	28.0	36.6	30.0	69.0	88	174

This very slow rate of fall in tensile strength with the increase of tempering temperature in the range of 600 deg. C. to 750 deg. C. is very useful commercially, as it allows quite a wide range of temperature to be used when articles have to be tempered to produce a definite tensile strength. The following physical tests carried out on hot-rolled and annealed sheets are of interest, as they show very little difference in tensile strength between the pieces cut longitudinally from the sheets and those cut crosswise:—

TABLE II.—*Tests of 18-gauge Sheets, Hot-rolled and Annealed.*

Direction of test.	Yield point	Tensile strength	Elongation.	Reduction of area.
	Tons per sq. in.	Tons per sq. in.	Per cent.	Per cent.
Longitudinal	16.7	30.0	19.0	38.1
Do.	18.5	31.0	16.0	36.4
Crosswise ..	19.3	33.6	13.0	33.1
Do. ..	19.0	33.0	12.0	33.5

The Erichsen test figures shown in Table III, made on the same sheets, give values which are as good as the best-quality deep-stamping mild-steel sheets:—

TABLE III.—*Cupping Tests of Hot-rolled and Annealed Sheets.*

Thickness of test piece. Inches.	Erichsen values; depth of bulge in mm.		
	1	2	3
0.070	9.5	9.3	10.0
0.059	9.5	9.6	9.6
0.047	9.2	9.5	9.5
0.036	8.4	7.9	8.2
0.028	8.6	8.4	8.3
0.020	7.6	7.3	7.4
0.015	6.3	6.7	6.8

The physical tests made on wire (Table IV) show that this material does not harden up to the same extent as ordinary steel wire to give high-tensile values due to the cold work put on the metal when drawn; but it must be remembered that the carbon content of this mild stainless steel is very low and that the chromium present evidently does impart this property of strain hardening, as does the carbon in ordinary steel wire. Wire rod of 0.246 in. dia., as rolled and annealed, showed a tensile strength of from 41.6 to 43.9 tons per sq. in.

TABLE IV.—*Tensile Tests of Wire.*

Drawn to.		Tensile strength.
Gauge No.	Diam., inches.	Tons per sq. in.
5	0.212	68.0
6	0.192	68.0
7	0.176	68.5
8	0.160	68.5
9	0.144	69.0
10	0.128	70.0
13½	0.086	75.0
18	0.048	80.0

The finest wire was bent 25 times through 90 deg. over a 5-mm. radius, and stood in torsion 58 twists on 8-in. gauge length before breaking.

The uniformity of chemical analysis got from mild stainless steel made by the Hamilton-Evans process is shown by figures given in Table V, which in the original Paper gives 40 analyses taken from casts made in the ordinary course of works practice and not from casts which have been given any special attention during melting:—

TABLE V.—*Percentage Composition of Mild Stainless Steel.*

No.	C.	Si.	S.	P.	Mn.	Ni.	Cr.
1	0.100	0.420	0.019	0.010	0.24	0.39	12.00
2	0.090	0.510	0.019	0.014	0.28	0.42	12.09
3	0.090	0.480	0.027	0.015	0.25	0.39	10.63
4	0.085	0.510	0.018	0.011	0.28	0.36	12.34
5	0.090	0.540	0.019	0.013	0.28	0.36	12.01
6	0.100	0.550	0.018	0.009	0.25	0.54	11.97
7	0.080	0.430	0.018	0.029	0.32	0.24	11.93
8	0.090	0.400	0.016	0.021	0.30	0.23	11.96
9	0.085	0.340	0.016	0.020	0.32	0.26	11.47
10	0.095	0.310	0.020	0.024	0.28	0.25	11.78

Resistance to Corrosion.

The Paper gives some particulars of the effect of acids, alkalies and chemicals and chemical solutions, etc., on mild stainless steel. Dilute nitric acid attacks the metal, although slightly; strong nitric acid has practically no effect; but sulphuric acid and hydrochloric acid attack rapidly in all strengths. Solutions of ammonium chloride, ammonium sulphate, ferric chloride, and copper chloride attack stainless steel. On the other hand, benzol and petrol have no effect. Tap water also produces no action; sea water, even under alternate wet or dry conditions, has no effect. Exposure to steam has very little effect under normal conditions. Erosion action is also resisted very well. Oils and greases have no effect.

In districts where the atmosphere contains acids they have varying effects. The atmosphere in all towns contains considerable quantities of dust and iron oxide which will get deposited on the article exposed, forming a brown deposit. This deposit can be rubbed off and leaves the original surface unaffected. Weathering in country districts has no effect, even when samples are exposed to all

types of weather for long periods. Samples left in rivers for a considerable time show no corrosion.

It is well known that when two dissimilar metals are placed in contact in a suitable electrolyte, a galvanic action is set up which corrodes the electro-positive metal. This is found to be the same when mild stainless steel is in contact with copper, bronze and brass under such conditions. Mine water has no effect on this material even though it contains sulphuric acid, which in itself will rapidly attack the material, as mine water also contains ferric sulphate in solution which evidently inhibits the attack of the sulphuric acid.

It is generally thought that mild stainless steel must be heat-treated in some way or finished with a high polish before it gives its maximum rustless or stainless properties. This is not so, as material which is in the annealed condition will give equally as good resistance to corrosion whether it be polished or simply pickled to remove all scale. Specimens which have been tested show that the polished pieces are no better than the pickled pieces. Of course, a polished surface will not allow dirt to adhere to it in the same way as a pickled or matte surface, but the presence of dust on a surface is an entirely different thing from corrosion, although the adhering of dust to a surface is often mistaken for corrosion.

Heat Resistance or Non-scaling at High Temperatures.

One of the valuable properties of mild stainless steel is its behaviour at high temperatures. When pieces of the material which have been polished are heated up gradually, temper colours appear on the surface similar to those obtained when ordinary carbon steels are heated up, but in the case of mild stainless steel these temper colours appear at much higher temperatures as seen from the following Table VI.

TABLE VI.—*Table of Temper Colours.*

Colour.	Mild stainless steel. Deg. C.	Ordinary steel Deg. C.
Pale straw ..	290	225
Straw	340	235
Brown purple..	390	265
Purple ..	450	280
Bright blue ..	530	290
Dark blue ..	600	315

Up to temperatures of about 825 deg. C. mild stainless steel resists scaling to a remarkable degree, but above this temperature the material begins to scale to some extent.

Another valuable property is that at high temperatures it retains its strength much more than ordinary mild steel, as will be seen from the figures given in Table VII.

TABLE VII.—*Tensile Strength at High Temperatures.*

Temperatures. Deg. C.	Mild stainless steel. Tons per sq. in.	Mild steel. Tons per sq. in.
700	12.0	6.5
800	6.5	5.0
900	5.0	3.0

Hot-Rolling and Forging of Mild Stainless Steel.

The hot-working of this material has presented considerable difficulties owing to its air-hardening properties, and its red hardness properties. In addition to this, the material is most susceptible to surface seams and non-metallic inclusions when being hot-rolled or forged. All these difficulties have been gradually overcome by very careful investigation and collaboration with the rolling mills and forges working up this material.

The most suitable hot-rolling temperature for this material is from 1,050 to 1,100 deg. C., and it is essential that for rolling and forging the material should be brought up slowly to about 900 deg. C., and then slightly quicker to the rolling and forging temperature. It should be allowed to soak for a long enough period to ensure a uniform temperature through and through. For forging, it should be worked quickly and with rapid blows at temperatures of from 1,150 to 900 deg. C. Below from 900 deg. C. to 850 deg. C. it is not so easily deformed, and if any heavy work is put on the material after it has fallen below these temperatures it is very apt to be badly stressed or burst.

In rolling, the material should be rolled quickly and hot, and the first passes should be very light, after which ordinary drafts can be used provided the reduction is not too drastic. It is important that the drafts should be such that there is no chance of finning, otherwise the steel is apt to spread along the edges. Not only will this happen, but when a fin is formed, after the material has gone through the passes in the roll, due to the spread of the material, this fin will be rolled over or lapped into the material at the next pass.

It has been found that the steel spreads considerably more than mild steel, so that special precautions have to be taken in drafting the rolls for the passes to avoid this finning, as if this is not done the material over-gorges the roll and swabs out and forms a fin. This has been found to be the case in rolling down from ingots to billets, sheet bars, etc., from billets to bars (all sections, rounds, squares, hexagons, flats, etc.), wire rod, strip, etc., and success has only been obtained after taking the above precautions. In fact, it has been found necessary when new sizes are required, even after considerable experience in rolling has been gained, to put through experimental pieces to find out the proper adjustment for the rolls.

Annealing.

The critical range of mild stainless steel runs from about 865 deg. C. to 965 deg. C., which is very wide, due to the slowing of the rate of carbon diffusion by the presence of chromium in the steel. To anneal mild stainless steel to obtain the maximum softness, it should be heated up slowly to about 1,000 deg. C. and held at this temperature for a period of time in proportion to the mass of metal, and then allowed to cool off slowly in the furnace, making sure that no currents of cold air enter the furnace, otherwise hard patches will be found in the steel where these currents of cold air have come into contact with the material. Although steel annealed this way has the maximum degree of softness, it is not a desirable condition in which to have the steel for easy machining. The steel in this state is very soft and tough, and so drags and tears when machined, leaving a very rough surface.

To soften the material for good machining properties or cold-drawing and cold-rolling, it is best to anneal at from 750 to 800 deg. C., preferably about 780 deg. C., and then to cool in the furnace, or draw and cool in the open air. As the lowest point of the critical range is not reached by this method, it is really a high-temperature drawing process, and not annealing, in which the steel is drawn to a temperature below the critical point.

The Brinell hardness got from annealing the steel at 1,000 deg. C. is about 150, and by softening by high-temperature drawing at 780 deg. C. the Brinell hardness obtained is about 175 to 180. It must always be remembered that mild stainless steel has distinct air-hardening properties, so that it should always be annealed or high-temperature drawn at 750 deg. C. to 800 deg. C. as stated above, after it has cooled down from a hot-rolling or forging temperature, before it can be successfully machined or cold-worked.

Cold-Rolling and Drawing.

The material will cold-roll, cold-draw and deep-draw or press very well, but owing to the percentage of chromium in the metal, the depth of each draw, when the steel is being deep-pressed or drawn, obtained at each operation is only about half that obtained when working on mild steel, before the material must be annealed. In cold-rolling and cold-drawing, the reduction of one gauge at a pass can be used, but it is found necessary to anneal after every second or third pass. In cold-drawing bars of mild steel, it is the usual practice to have the bars hot-rolled, a $\frac{1}{16}$ in. larger in diameter than the finished size, and then the $\frac{1}{16}$ in. can be drawn in one pass; but with mild stainless steel it requires two draws of about $\frac{1}{32}$ in. each to reduce the bar to the finished size. As with all materials, a distorted surface is always more liable to rust, and the same applies to mild stainless steel, especially if the surface happens to be unevenly distorted.

In cold-working, strains are always set up in the material, and sometimes strained parts are not confined to the surface where they can be ground off, but are inherent in the steel and the strains must be removed by heat treatment. These strains are not only liable to cause rust, but are apt to cause the steel to crack if put into service. It is thus evident that it is advisable to anneal or high-temperature draw at 780 deg. C. all material which has been cold-worked in any way.

Pickling, Grinding and Welding.

The acid pickling baths generally used for this material are as follows: (1) 50 per cent. solution of hydrochloric acid used hot at 60 deg. C. to 70 deg. C.; (2) 15 per cent. solution of sulphuric acid used hot at from 60 deg. C. to 70 deg. C.; (3) ten minutes in a 50 per cent. commercial hydrochloric acid, then transfer without washing to 20 per cent. nitric acid for 25 minutes, both these solutions being worked cold. Of these three acid pickling solutions, No. 3 is the one which has given the most satisfactory results. Other methods which have been used for cleaning this steel are electrolytic pickling in an alkaline bath, which has been more or less successful for bars, etc., and articles of simple shapes. Acid pickles containing chemical salts to accelerate the action have also been used with considerable success.

The grinding of mild stainless steel must be carried out very carefully, as this material is more difficult to grind than ordinary steel. The metal dissipates heat very slowly, and great care should be taken in grinding in order that grinders' "scorch" is not produced. Grinders' "scorch" is due to harsh or unskilled grinding and produces a brownish discoloration on the steel. Wet grinding is much better than dry grinding.

Mild stainless steel can be successfully welded by either the electrical process or by the oxy-acetylene method. It will not weld by the usual method of heating in a smiths' fire. In welding, the temperature of the metal at the weld is raised to a fairly high temperature, so that the material on cooling down will air-harden, and should be annealed before any turning, grinding or polishing is done.

American Pattern Standardisation.

A report on pattern equipment standardisation was read by E. S. Carman, Chairman of the Joint Committee. This Committee is composed of representatives of eight national associations, the American Foundrymen's Association being the sponsoring body, the other co-operating associations being the American Institute of Mining and Metallurgical Engineers, the American Society for Testing Materials, the American Malleable Castings Association, the Foundry Equipment Manufacturers' Association, the National Association of Pattern Manufacturers, the National Association of Purchasing Agents, and the Steel Founders' Society of America.

Three sub-committees have been organised, and have been studying the possibilities of pattern equipment standardisation under the following divisions:—Patternmaking, mounting the pattern, and flask equipment.

The general committee has approved for recommendation for adoption as standard colour marking for patterns and core boxes. Progress is being made on standardisation of pattern mounts and flasks. The pattern and colour markings approved are as follow:—

Surfaces to be left unfinished are to be painted black; surfaces to be machined, red; seats of and for loose pieces, red stripe on a yellow background; core prints and seats for loose core prints, yellow; stop-offs, diagonal black stripes on a yellow base.

Mr. Carman, in presenting this report, said he believed that the standardisation of flasks will save American industry millions of dollars now tied up in idle equipment. In fact, one representative foundryman is of the opinion that the scrap value of the flasks at his plant would be sufficient to bear the cost of an entire new set of the proposed standard flasks.

Size and Character of Grains of Non-Metallic Fillers.

Non-metallic fillers are pulverised minerals used in the preparation of various manufactured articles, of which graphite for foundry facings is an example. The subject has been studied by Mr. W. M. Weigel, and his results have been embodied in a Technical Paper 296, published by the American Bureau of Mines, Washington, D.C., at 15 cents. He summarises his conclusions as follow:—

In this there is given in detail a method for the fairly rapid determination of the average particle size of finely ground minerals, where the limiting range of size is so large, on the one hand, as to make ordinary methods of microscopic measurement impracticable, and, on the other hand, where the particles are nearly all too small for analysis by sieves. The method itself is not entirely new, but has been modified to make it applicable to the materials in question.

A brief outline of various methods of computing average particle size is given, and reasons are advanced for advocating the use of the average based on specific surface as especially applicable to fillers.

The limitations of the elutriation method are pointed out, and the possible use of the method in connection with microscopic count and measurement is shown.

The average diameters, as based on specific surface, for the grains of a number of representative fillers in common use are stated. The list is not by any means complete. It includes only materials now used. Most of the samples are from products now on the market. They are fairly representative of similar materials wherever produced. Tables that show the distribution of the different sizes in any one filler are given. The character of the grains of fillers made from different minerals is also given.

The author believes that a better knowledge of the average size of the particles, the distribution of the sizes throughout the mass, and the character of the surface and shape of the individual grains will result in a more efficient use of the non-metallic fillers and will often indicate the proper material to be used for a specific purpose without the expense and delay occasioned by having to try a large number in actual compounding or experimental manufacture.

The American Exchange Paper.

Dr. H. Ries, head of the department of geology at Cornell University, honorary member of the American Foundrymen's Association, a member of the executive committee of the Joint Committee on Moulding Sand Research, Chairman of the Sub-Committee on Moulding Sand Test Methods, and a pioneer in the field of moulding sand research, will present the 1925 American Foundrymen's Association exchange paper before the Institute of British Foundrymen. This Paper, "The Present Status of our Knowledge of Sand Testing," will review the developments of foundry sand testing in this country. Dr. Ries is an eminently able representative to present this subject before the British meeting, for he has been one of the most active members of the Joint Sand Research Committee, and much of the development of this research has been carried on under his direction at Cornell University. Dr. Ries first became interested in this work some twenty years ago, at which time he made surveys of the foundry sand resources of Michigan and Wisconsin, results of these surveys being published in early geological survey reports of these States. One of the earliest papers on this subject was presented by Dr. Ries before the 1906 Cleveland meeting of the American Foundrymen's Association describing test methods then used.

H. STOCKWELL & COMPANY, iron and steel merchants, Corporation Street, Manchester, have removed to more commodious premises at 10, Corporation Street, Manchester.

Trade Talk.

THE blast furnaces of the Butterley Company, Limited, near Alfreton, Derby, are being dismantled.

G. W. WILKINSON & SONS, iron and ore merchants, have removed to 49, Basinghall Street, Leeds.

THE BLAST FURNACE at Dudley Hill, Bradford, Yorks., of Wm. Woodhead & Son, Limited, is being dismantled.

ROBERTS, GLAZEBROOK & COMPANY, LIMITED, Cobden Works, Gower Street, Birmingham, have removed to James Road, Tyseley, Birmingham.

DAVID COLVILLE & SONS, LIMITED, announce that the number of the London office has been changed from 54 to 107, Old Broad Street, E.C.2.

A FIRE BROKE OUT at the works of Lanceley's, Limited, engineers and iron founders, of Brook Street, Chester, recently, but the damage was not heavy.

STABLEFORD & COMPANY, LIMITED, Coalville, Leicestershire, have booked wagon orders sufficient to keep the works going full time for twelve months ahead.

NINE EMPLOYÉS of Accles & Pollock, Limited, iron founders, etc., of Oldbury, have been presented with a gold watch by the directors on completing 25 years' service.

THE VARIOUS COUNCILS proposing to erect steel houses of the Weir type for inspection by the public are to receive from the Ministry a subsidy of £200 per house towards the expenditure.

CUIRASS PRODUCTS, LIMITED, 69, Victoria Street, Westminster, S.W.1, have taken over more commodious London offices at Abbey House, Victoria Street (entrance Tothill Street), London, S.W.1.

IN ACCORDANCE with the ascertainment issued last week, the wages of blast furnacemen on the North-East Coast are immediately reduced by 6½ per cent., bringing them to only 12½ per cent. above the standard.

THE ASSOCIATED BRITISH MANUFACTURERS (EGYPT), LIMITED, representing Siemens Bros., Limited, have secured a £50,000 contract from the Egyptian Government for the installation of an automatic telephone exchange at Cairo.

THE PRIESTMAN COLLIERIES, LIMITED, Milburn House, Newcastle-upon-Tyne, have taken over the works and business of the Newcastle Alloy Company, Limited. The business is being carried on without change in the personnel or management.

THE FLEXIBLE SHAFT MANUFACTURING COMPANY, Church Street, Stratford, have appointed the Westminster Tool & Electric Company, Limited, Westool Works, Putney Bridge Road, London, S.W.15, selling agents for their flexible shafts and accessories.

H. WHARTON, LIMITED, electric crane builders, of Reddish, Manchester, have secured a contract from the British Reinforced Concrete Company for four 5-ton electric travelling cranes, 75 ft. span; also a contract for two 50-ton, 4 motor electric travelling cranes, 50 ft. span, for the London Midland & Scottish Railway Company, at Horwich, Lancashire.

VICKERS, LIMITED, have become associated with the Combustion Engineering Corporation, Limited, who represent in Canada the interests of the International Combustion Engineering Corporation. The consolidation takes effect by the formation of a new company, to be known as Vickers & Combustion Engineering Company, Limited, with offices in Montreal, Toronto, Winnipeg and Vancouver. The entire business of the Combustion Engineering Company, Limited, and of its parent company, the International Combustion Engineering Corporation of New York, and the Canadian sales agency of Vickers, Limited, along with the sales of the industrial department of Canadian Vickers of Montreal, comes under the one executive control. The board of the new amalgamated company includes the following: Commander Sir A. Trevor Dawson, chairman; Mr. G. E. Learnard, vice-chairman; Mr. A. J. T. Taylor, president and chief executive officer, and Mr. A. H. Gilham, first vice-president.

THE SHAREHOLDERS of John Spencer & Sons, Limited, Newburn, have received a circular from Mr. Lynas, secretary, to the following effect:—"A meeting of shareholders will be held at an early date for the purpose of receiving a statement with respect to the position of the company and of passing an extraordinary resolution for the voluntary winding-up of the company and the appointment of a liquidator." A circular has also been received by the debenture-holders from Cooper & Jackson, solicitors, Newcastle, stating that they are desired by Mr. Ralph Spencer to state that the company, not being able to provide for the repayment of debentures due on January 1, and it being imperative that its assets should be protected and an opportunity secured for the consideration of the question of reconstruction, an action has been commenced by Mr. Spencer, on behalf of himself and other first debenture-holders, for the appointment of receivers and manager, and it is proposed to apply to the court for the appointment of Mr. W. F. King, of the firm of Price, Waterhouse & Company.

Contracts Open.

Bikaner, India, March 15.—Railway material, etc., for the Stores Committee, Bikaner, India. Mr. Nihal Chand Sarwal, secretary, Stores Committee, Bikaner. (Fee, 10s.)

Cape Town, June 3.—33-in. internal diameter lap-welded mild steel pipe coated, for the City of Cape Town. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

Orpington, Kent, January 19.—Cast-iron signposts, for the Bromley R.D.C. Mr. L. J. Small, Highway Surveyor's Office, Farnborough, Kent.

Australia, February 11.—One oscillating tool-grinding machine, for the Victorian Government Railways Commissioners. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1.

Bucharest, January 30.—Weighing machines, for the Roumanian State Railways. The Department of Overseas Trade.

Personal.

MR. STANLEY BROTHERHOOD, chairman of Peter Brotherhood, Limited, of Peterborough, has been elected chairman of directors of Humber, Limited.

MR. A. H. STURDEE, works manager at the English Electric Company's works, at Stafford, has been appointed chief works manager with Ruston & Hornsby, Limited, Lincoln.

SIR LIONEL PHILLIPS, BART., has resigned his seat on the board of the British Metal Corporation, Limited, and Sir Reginald Sothern Holland, Bart., has been elected a director in his place.

MR. J. R. C. GARNHAM, son of the late Mr. J. C. Garnham, has been admitted into partnership with J. B. Garnham & Sons, metal merchants, etc., 44, Devonshire Street, Theobald's Road, W.C.1.

MR. WILLIAM SHAW WHITE, who died in Pawtucket, R.I., recently, became connected with the J. S. White Company, ironfounders, immediately after graduation from Brown University in 1886. He was prominent in the foundry trade of New England and was one of the party of American Foundrymen who visited Europe last year. He was in his sixty-second year.

Wills.

HADLEY, A. E., proprietor of the Star Foundry, Coventry	£4,760
CAIRD, A., director of Caird & Company, Limited	£88,787

Patent Specifications.

Particulars of complete specifications accepted, furnished by Mr. Eric Potter, Patent Agent, of Lonsdale Chambers, 27, Chancery Lane, London, W.C.2. Printed copies of the specifications in the following list are now on sale.

217,885. LANZ, H. (Firm of). Refined cast iron. June 23, 1923.

216,869. RAYM, W. Casting process for incorporating shafts, etc., with castings. June 2, 1923.

226,270. WADE, H. (UNITED ENGINEERING AND FOUNDRY COMPANY). Casting of metals. September 17, 1923.

226,297. RICHARDSON, W. W. Construction of disconcentrator for minerals. September 25, 1923.

212,515. HOLLEY, E. Permanent metal moulds. March 5, 1923.

226,461. HOFLER, H. Devices for holding and heating articles subjected to welding operations. May 23, 1924.

226,581. MCGINNESS, M. Apparatus for disintegating ore and similar material. Aug. 25, 1923.

226,618. HOUNSELL (ENGINEERS), LIMITED, J., HOUNSELL, W., and FILLERY, T. C. Method of, and means for, handling molten substance.

218,981. WITTIG, A. Method of making alloys from iron and alloying metal. July 12, 1923.

216,128. DEUTSCH, B., and GES. FUR. CHEMISCHE PRODUKTION. Process for the elimination of iron and water. May 14, 1923.

226,751. MASCHINENFABRIK ESSLINGER and GREINER, F. Processes for incorporating manganese with iron. July 31, 1924.

MESSRS. B.S.A. TOOLS, LIMITED, have arranged to give a public demonstration of automatically hardening their products in a Wild-Barfield electro-magnetic furnace at the Birmingham Corporation Electrical Showrooms (Industrial Section), 21, Paradise Street, Birmingham, commencing Monday, January 19, and continuing each day throughout the week.

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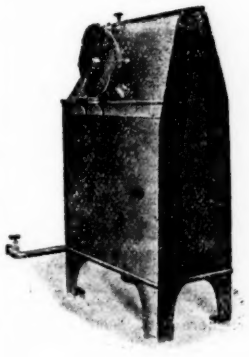

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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Although as yet too early to forecast the immediate future of the pig-iron trade with any degree of accuracy, there can be no doubt that a very confident tone in the market prevails at the moment, and on Tees-side especially the consensus of opinion inclines to a more optimistic view of the position. As far as home consumers are concerned, there is already increasing interest in the foundry section, and inquiries for forward delivery are more frequent, based apparently on the fact that orders for castings are in better volume than of late, which infers the more active buying in the near future. While the outlook in the home trade is good, there is as yet observable but little movement for the better in the export trade. Pig-iron is still being offered very cheaply on the Continent, notwithtanding all that has been said as to increasing costs of production abroad. Some export inquiry continues to come forward, however, including a certain amount from Germany, and a little business has been done. No. 3 G.M.B. is quoted at 80s. 6d., though no doubt less would be taken for a substantial contract over a period. No. 1 is 85s. 6d., No. 4 foundry 79s. 6d., and No. 4 forge 79s. per ton.

The hematite market is quiet at the moment, but steady, and an optimistic view is taken of the outlook. Several additional furnaces are due to be put in this month. On 'Change this week mixed numbers were rather weaker at 87s. per ton, and this figure would still be shaded for substantial business. No. 1 was at a premium of 6d. per ton. On the West Coast prices are unchanged, with Bessemer mixed numbers 99s. per ton delivered at Glasgow, 102s. 6d. per ton delivered at Sheffield, and 107s. per ton delivered at Birmingham.

LANCASHIRE.—Business in the local markets for foundry iron is continued on a more active scale, but with considerable caution on the part of buyers, who are apprehensive that increased demand may induce producers to advance prices. Sellers of Derbyshire No. 3 iron are still quoting 90s. per ton delivered in the Manchester district, and there is a moderate amount of buying going on. There is still no Lincolnshire foundry iron offered at this price, but Northamptonshire can be bought here at a little less. Cleveland iron has been slightly easier, but this is said to be merely the result of accumulations at the furnaces during the holidays.

THE MIDLANDS.—Anticipations of some favourable developments in the foundry pig position at the quarterly meeting last week were hardly realised as fully as had been desired, but there was a slight movement in the demand from the local ironfounders. The business in foundry iron is likely to revive, as consumers here have been cutting down stocks owing to stocktaking, and will have to be in the market shortly for fresh supplies. Pig-iron makers are not disposed to sell beyond the end of February, being somewhat in the dark as to the price of furnace coke. Ruling quotations for pig-iron are as follow:—Derbyshire No. 3 foundry, 82s. to 82s. 6d.; Staffordshire No. 3 foundry, 87s. 6d.; Northants. No. 3 foundry, 76s. to 77s.

SCOTLAND.—The resumption of business after the holidays has been on a quiet scale, a number of works being still closed, while the tone of the market is easy and the quotation for No. 3 Scotch foundry remains at 90s. per ton at the furnaces. The makers are not keen sellers at the present level, as they maintain that to sell at to-day's price is only making sure of a loss, whereas they are hopeful that better prices may be obtained later, failing which they will resort to closing down more furnaces.

Finished Iron.

Business in this section of the industry continues disappointing in the extent of the orders in hand, and though makers of the best qualities of marked bars are fairly well employed, and in a comparative degree also mills engaged upon crown brands, South Staffordshire producers are poorly off for work. In the Black Country it is reported that another of the few remaining mills has closed down, and the works making the nut and bolt irons are receiving little support. The local figure for bolt iron is £11 15s. and crown £12 15s., but foreign supplies are offered freely at £8 delivered. The nut and bolt trade is not busy, and few orders of any size are being given out in any direction. Iron sheets are quoted at £16 basis delivered Birmingham, and the demand keeps up to a fair level. There is likely to be a call in the near future for this class of sheet for gasholder work.

Steel.

In the Sheffield market for steel there are indications of an improved demand for billets, but so far the promise has not materialised to any considerable extent. Basic billets are beginning to look up, particularly soft qualities, medium and hard remaining dull. Steel manufacturers report quite a substantial amount of buying of Sheffield steel, and Germany is also taking some best tool steels. A good many inquiries are also coming from Russia. There has been a very fair inquiry for tinplates of late, but so far not a great deal of business has resulted. The tone of the market is quite firm, and some makers are now quoting above the official minimum price.

Scrap.

Reports from the various markets for scrap metal indicate a much more hopeful tendency, and with few exceptions prices all round are distinctly firmer. In Lancashire, the foundry trade is not yet buying very much cast scrap, but there is a stronger feeling amongst dealers, and the best lots of broken textile machinery iron are held firmly for 90s. per ton delivered. There is a good deal of commoner qualities of scrap about, and for these from 82s. 6d. to 87s. 6d. per ton is quoted. It is expected that ironfounders will be larger buyers of scrap in the near future, as a revival of the trade is looked for this spring. At Sheffield, machinery cast-iron scrap for the foundry is quoted 95s. delivered West Riding stations. A fair demand is operating for turnings and borings for blast furnaces at about 60s. per ton delivered, and burnt metal for the same purpose is quoted at from 65s. to 67s. 6d. per ton delivered.

Metals.

Copper.—The position in the market for standard metal has been considerably strengthened of late by the steady growth of consumers' demand, while, on the other hand, there has been a brisk speculative movement both on home and Continental account. Substantial purchases of electrolytic have also been made by the chief Continental countries. The supply of metal in second-hand has become very scanty, the bulk of available supplies having been absorbed to meet early trade needs, and dealers have thus been more inclined to enter into new commitments. Current quotations :—*Cash* : Thursday, £66 5s.; Friday, £66 15s.; Monday, £67 5s.; Tuesday, £66 15s.; Wednesday, £66 15s.

Three Months : Thursday, £67 7s. 6d.; Friday, £67 17s. 6d.; Monday, £68 7s. 6d.; Tuesday, £67 17s. 6d.; Wednesday, £67 17s. 6d.

Tin.—Movements in standard tin of late have disclosed a rising tendency in values, which may be largely ascribed to the favourable sentiment engendered by the virtual extinction of the invisible stocks held under the Bandoeng agreement, and to the fact that the market has now to rely upon current production and supplies. Fortunately, supplies are ample to meet all needs for the moment, but consumption is expanding, and, should the tinplate trade be subject to a sudden spurt of activity, the advance would undoubtedly be carried considerably further. Current quotations :—*Cash* : Thursday, £270 7s 6d.; Friday, £270 10s.; Monday, £270; Tuesday, £266 15s.; Wednesday, £265 15s.

Three Months : Thursday, £274 5s.; Friday, £274 15s.; Monday, £274; Tuesday, £271; Wednesday, £269 15s.

Spelter.—Dealings in this metal have been of an extensive character, largely on home and Continental account, and, although new supplies have been coming in on a fairly liberal scale, and at least ample enough to cope with current needs, prices moved steadily upwards. Values are now about equal to the highest level that was attained in the closing months of 1923, while indicating an appreciation of over £4 a ton from the lowest point reached at one time during last November, when the market was affected by trade dullness and some rather free selling. Current quotations :—*Ordinary* : Thursday, £38; Friday, £38 6s. 3d.; Monday, £38 11s. 3d.; Tuesday, £38 13s. 9d.; Wednesday, £38 15s.

Lead.—The market for soft foreign pig has been very strong again, and there has been some adjustment in the more distant positions. Consumers seem to take the view that the inflated level of values has now become more or less permanent, but this is still open to doubt. Current quotations :—*Soft foreign (prompt)* : Thursday, £42 12s. 6d.; Friday, £42 15s.; Monday, £43 15s.; Tuesday, £43 15s.; Wednesday, £43 2s. 6d.